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REPORT
OF
THE SETHUSAMUDRAM PROJECT COMMITTEE

Price: Rs. 7·75 nP. or 12 sh. 6d.

RESOLUTION

New Delhi, the 1st November, 1955.

No. 9-PII(23)/55.—The Government of India are pleased to constitute an Expert Committee to examine and report on the feasibility and desirability of connecting the Gulf of Mannar and the Palk Bay by cutting a channel at the approaches to the Adam's Bridge for enabling deep sea ships to navigate in safety from the west to the east coast of India. It has been suggested that the construction of such a passage would increase the potentiality of the port of Tuticorin if it is to be developed into a deep sea port. The composition of the Committee which may be known as the Sethusamudram Project Committee, will be as follows :—

Shri A. Ramaswami Mudaliar—*Chairman.*

The Chief Commercial Superintendent, Southern Railway.

Shri B. N. Chatterjee, Retired Chief Engineer, Calcutta Port.

Capt. J. R. Davies, Nautical Adviser to the Government of India, Directorate-General of Shipping, Bombay—1.

Shri R. A. Gopalaswami, I.C.S. Secretary to the Govt. of Madras, Home Department, Madras.

Member—Secretary.

2. The terms of reference of the Committee will be as follows :—

(*a*) What is the extent to which shipping in general is likely to benefit by, and in practice to take advantage of the shortened sea route *via* the proposed Sethusamudram Passage?

(*b*) Would the advantages, likely to be secured be commensurate with the expenditure involved?

(*c*) What are the traffic prospects of the Tuticorin Port during the next decade—

(*i*) if the Sethusamudram Passage is provided; and

(*ii*) if the Sethusamudram Passage is not provided?

(*d*) In the light of the traffic assessment, should the Tuticorin Development Project be proceeded with? If so, what should be the timing—

(*i*) immediately by itself and independently of the Sethusamudram Project;

(*ii*) simultaneously with the Sethusamudram Scheme; or

(*iii*) at a later stage and if so, when ?

3. The Committee is requested to submit its report to Government by the end of January, 1956.

N. M. AYYAR
Secretary.

REPORT OF THE SETHUSAMUDRAM PROJECT COMMITTEE

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REPORT OF THE SETHUSAMUDRAM PROJECT COMMITTEE

SECTION I—INTRODUCTORY

1. *Subject matter of report.*—In their resolution No. 9-PII(23)/55, dated 1-11-1955, the Government of India constituted us into a Committee which was named in the resolution as the "Sethusamudram Project Committee". We were charged with the duty of examining and reporting "on the feasibility and desirability of connecting the Gulf of Mannar and the Palk Bay, by cutting a channel at the approaches to the Adam's Bridge for enabling deep-sea ships to navigate in safety from the west to the east of India". Our attention has been drawn in this resolution to the suggestion that "the construction of such a passage would increase the potentiality of the Port of Tuticorin, if it is to be developed into a deep-sea port".

2. *Terms of Reference.*—Our terms of reference have been defined as follows:—

(*a*) What is the extent to which shipping in general is likely to benefit by and in practice to take advantage of, the shortened sea route *via* the proposed Sethusamudram Passage?

(*b*) Would the advantages likely to be secured, be commensurate with the expenditure involved ?

(*c*) What are the traffic prospects of the Tuticorin Port during the next decade—

(*i*) if the Sethusamudram Passage is provided; and

(*ii*) if the Sethusamudram Passage is not provided?

(*d*) In the light of the traffic assessment should the Tuticorin Development Project be proceeded with?

If so, what should be the timing—

(*i*) immediately by itself and independently of the Sethusamudram Project;

(*ii*) simultaneously with Sethusamudram Project Scheme; or

(*iii*) at a later stage, and if so, when?

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3. *Sethusamudram Project Memorandum.*—On 19th May 1955, the Government of Madras addressed a letter to the Government of India recommending the technical investigation of what was then, for the first time, described as the " Sethusamudram Project ". The name Sethusamudram was given to the Gulf of Mannar and Palk Bay jointly, on the basis of their being united into a single sea by a navigable canal or passage. The project, in itself, was not new. It was a revival, in modified form, of what had been known and considered in the past as the "Rameswaram Ship Canal Scheme". The Government of Madras forwarded a Memorandum outlining the "Sethusamudram Project" which was estimated to cost 4 crores. The Memorandum was accompanied by a detailed note explaining the idea of Sethusamudram, summarising the old history of the Rameswaram Ship Canal Scheme, and explaining how the objections which were raised against the old scheme could be met and why it was now necessary that the Project should be taken up for execution as part of the Second Five-Year Plan.

4. *Tuticorin Harbour* (*Preliminary*) *Investigation Report.*—On 27th January 1954, the Government of Madras had addressed the Government of India regarding another proposal to the effect that the Port of Tuticorin should be improved and developed into a 20 feet harbour and that this development project should be included in the Second Five-Year Plan. The proposal was

considered by the National Harbour Board at its meeting on 29th April 1954. The Board recommended that the necessary preliminary investigations should be carried out. Accordingly Shri B. N. Chatterjee, one of the Members of our Committee, was deputed and he carried out preliminary investigations during the last quarter of 1954. The report submitted by him was received by the Government of India on the 8th of March 1955. In this report, Shri B. N. Chatterjee estimated the cost of the improvements proposed by him at Rs. 4½ crores. As a result of further correspondence, the detailed investigation of the Project was decided upon and arrangements for such investigation were under consideration. At that stage the Government of India observed the inter-relationship between the two Projects and the need for taking co-ordinated decisions. This is why, as mentioned already, the terms of reference to our Committee makes reference specifically to both projects. The preliminary investigation report submitted by Shri B. N. Chatterjee is thus one of the two basic documents for our consideration.

5. *Old records relating to the Rameswaram Ship Canal Scheme and development of Tuticorin Harbour.*—A full account is given in the Memorandum and preliminary Investigation Report referred to above of the various schemes which had been considered at different times in the past in respect of the Rameswaram Ship Canal Scheme as well as the development of Tuticorin Harbour. The old records relating to these schemes were made available to us by the Government of Madras. We have made a careful study of these records and taken full note of all the information contained in them in so far as they are relevant to our present investigation. The study of these old records has been especially useful in bringing to our notice the main navigational and engineering problems which required our attention. They also enabled us to perceive the true nature of the inter-relationship between the two Projects which have been referred to us.

6. *Port Traffic Data.*—We addressed all Port authorities in charge of the major Indian Ports in the Bay of Bengal and the Arabian Sea for information regarding the ships which called at these ports in recent years. We have received information from Madras, Calcutta, Tuticorin, Cochin and Bombay. Similar information about Rangoon and Chittagong was also secured through the Indian Missions in Burma and Pakistan. With the help of staff placed at our disposal by the Government of Madras, we have had the data received from these ports scrutinised, sorted and analysed. The information received from Madras and Calcutta is of particular importance for our enquiry. Abstracts have been compiled of data relating to these ports. They provide a solid basis for the assessment of traffic, as well as of revenue derivable from the Sethusamudram Project.

7. *Other data relating to shipping and sea-borne trade.*—We have also been supplied with a good deal of other statistical information of shipping and sea-borne trade compiled for our use by various persons and bodies including the Chief Commercial Superintendent, Southern Railway, the Director of Statistics, Madras, the Coal Commissioner, Calcutta, the Deputy Salt Commissioner, Madras, the India Steamship Company, Calcutta, the Indian Coastal-Conference, Bombay, Messrs. A. & F. Harvey & Company, Tuticorin, and the three principal Oil Companies (Burmah Shell, Standard Vacuum Oil and Caltex).

We have carefully studied the information thus obtained.

8. *Reconnaissance of the Sethusamudram Navigation Route.*—Accurate ascertainment of the actual depth of water at present available in different parts of Sethusamudram is of vital importance for our enquiry. The charts published by the British Admiralty contain this information. It is, however, necessary to be quite sure that the information contained in these charts is up-to-date and that no material changes have taken place since the original surveys were made.

In particular, it was necessary to have full information regarding the junction of Sethusamudram with the Bay of Bengal in the region known as Palk Straits. We, therefore, addressed a request to the Chief Hydrographer of the Indian Navy at Dehra Dun, that a particular area in this region which was specified by us may be resurveyed and the depths obtained therein may be communicated to us. We were informed, however, that the programmes for the present session had already been arranged and that it was not possible to undertake a survey as requested by us except after October 1956.

In the circumstances, it became necessary for two Members of the Committee (Captain J. R. Davies and Sri B. N. Chatterjee) themselves to undertake local investigation. The Tuticorin Port Trust placed the Tug 'Mannar' at their disposal. The two Members carried out a reconnaissance of the entire route from Tuticorin to Rameswaram Island; around Rameswaram Island; between Rameswaram Island and Palk Straits; and finally the particular area referred to above. This reconnaissance was undertaken on two separate occasions, once in December 1955 and once again in February 1956. As a result of the soundings then taken, as well as other observations made and local enquiries* carried out during these trips it has become possible for us to feel satisfied that the Admiralty Charts correctly represent the present state of affairs in general; and also that there is no indication of any decrease of depths in the area investigated. We believe that we have now secured adequate confirmation of other valuable information relating to wind, sea, swell and other local weather conditions in the Sethusamudram area, to which reference is found in old records.

9. *Other local enquiries and surveys.*—In the course of our enquiry, we considered it desirable to confirm and supplement the information contained in the old records relating to the nature of the strata required to be dredged or excavated in connection with both Projects. The necessary borings were carried out and the results have been made available to us by Sri J. M. Frederick, the Chief Engineer of Madras Government as well as by the Tuticorin Port Trust.

10. *The Committee Meetings.*—The full Committee met formally in three different sessions. The first session was held in Madras on the 5th and 6th of December 1955. As a result of discussions at this session, the processes of collection of information were set in train; and the first reconnaissance of the Sethusamudram area was undertaken.

The Committee held its second session at Tuticorin between the 24th to 26th of January 1956. In addition to carrying out local inspection, the Committee heard the views of representatives of the Tuticorin Port Trust, Chambers of Commerce and Trade Associations and other persons and bodies in Tuticorin.

Thereafter the investigations of the Committee were carried on in informal sub-Committee discussions. These discussions were based on the results of study of old records and statistical material as and when they became available, as well as a number of very important technical conculsions which emerged from local investigations.

The final session of the full Committee was held in Madras between 23rd and 27th of March, when we formulated our conclusions and recommendations, as well as our answers to the terms of reference. The Report was then drafted and approved at the meeting held on 27th March.

11. *Main conclusion.*—Our main conclusion may be stated, at the outset :—

In our opinion, the two projects which have been referred to us are so closely related to one another that they should be regarded as two parts of one and the same undertaking—an integrated Sethusamudram Project. The main objective of such a project should be visualised as the establishment of a new Sethusamudram Navigation Route as an alternative to the existing longer and more exposed sea route round Ceylon. The relationship between the Port and Harbour of Tuticorin and the new route should be regarded as exactly the same as the relationship between the Port and Harbour of Colombo and the present Round-Ceylon-Route. In our opinion, it is feasible and desirable to design an integrated project, which will secure these objectives with assured navigational safety, and at a cost which will be commensurate with the advantages likely to be secured thereby. The execution of such a project can be completed before the end of the Second Five-Year Plan Period.

[*The local enquiries at Mandapam were especially useful. The local pilots and sailors including an old Captain of Sailing Vessels with forty years experience gave valuable information.]

Section II.—Integrated Project—Proposed design and estimate of cost.

12. *Sethusamudram Navigation Route and Nautical Note.*—A chart has been prepared showing the lay-out of the Sethusamudram Navigation Route as recommended by us. The chart is accompanied by a note which furnishes a detailed technical explanation of the navigational aspects of our proposal. There is also a list of the additional navigational aids and improvements required to existing aids on the proposed navigation route. These documents are, respectively Parts A, B & C of Annexure I.

13. *Plan of Project.*—The integrated Project involves the execution of 10 different items of work as specified below :—

(1) Sethusamudram Canal.
(2) Sethusamudram Canal South Approach Channel. (Outer Section).
(3) Sethusamudram Canal South Approach Channel. (Inner Section).
(4) Sethusamudram Canal North Approach Channel.
(5) Sethusamudram Canal Lock.
(6) Sethusamudram Canal Bridge.
(7) Bay of Bengal Approach Channel (Middle Channel, Palk Straits).
(8) Tuticorin Harbour Approach Channel.
(9) Tuticorin Harbour—Anchorage, Pier and Causeway.
(10) Project Headquarters—Lands and Buildings.

The nature of these works together with the estimated cost of each is briefly explained below. Ten drawings and four statements have been prepared in order to furnish further details of these various items of work. The drawing and statements are Annexure II.

14. *Navigational Safety.—Overriding consideration.*—We may say, at the outset, that both in settling the lay-out of the route, as well as in planning the project in detail, we have kept before us the question of navigational safety as an overriding consideration. If the use of the new route is regarded by Shipmasters as being, in any respect, hazardous, it is unlikely that the route will be used merely because of saving in time and distance. We have, therefore, taken care to plan the project in such a way that the route proposed by us will be recognised as safe.

15. *The "Sethusamudram Medial Line" and the location of the Project to its west.*—One other consideration which we have kept in mind is the need to ensure that the navigational works and facilities proposed will be wholly under the control of the Government of India. The Government of Madras have informed us that a medial line of Sethusamudram has been delimited and accepted as the administrative boundary between India and Ceylon, in respect of the ownership of Chank and Pearl fisheries in the bed of the sea. The delimited line is marked on the Route Chart (Part A of Annexure I). It will be observed that all the project works are located to the west of this line.

16. *Unsuitability of Adam's Bridge : preference for Canal over Passage.*—We have been asked specifically to consider the proposal of cutting a channel at the approaches to Adam's Bridge in order to connect the Gulf of Mannar and the Palk Bay and thereby form the Sethusamudram. We have considered this site and advise against it. The origin of this suggestion is to be traced to the opinion formed by the Harbour Engineer to the Government of Madras in 1921, which was recorded in the following terms:

> "The approaches to the suggested channel at Adam's Bridge are much safer and more open than at Pamban and there is no possibility of trouble from shifting sand dunes, which is a very real trouble at Pamban adversely affecting both the canal and railways. It is very probable also that locks would be required at Pamban but not at Adam's Bridge. Speaking generally the latter is the simpler problem from an engineering point of view".

We observe that this opinion was expressed by the Harbour Engineer before he undertook the detailed investigation of the Rameswaram Canal Scheme. Subsequently, his detailed investigation was limited to the Island site and did not extend to Adam's Bridge. We consider that, had a detailed investigation also been made of Adam's Bridge, he would have revised his opinion. We are convinced that the Adam's Bridge site is unsuitable for the following reasons:—

Firstly.—The shifting Sandbanks in this area present a far more formidable problem—both at the stage of construction and during maintenance—than the sand dunes on the island site.

Secondly.—The approaches to a channel would be far too open with no possibility of construction of protective works. A channel at this site—even if it can be made and maintained (which is unlikely)—would entail definite navigational hazard.

Thirdly.—The channel would be bordering on the Sethusamudram Medial Line.

In these circumstances we have no doubt, whatever that the junction between the two seas should be effected by a Canal; and the idea of cutting a passage in the sea through Adam's Bridge should be abandoned.

17. *Site recommended for location of Sethusamudram Canal: superiority of recommended site to Rameswaram site.*—The Rameswaram Ship Canal Scheme was investigated on three different occasions during the last sixty years. On all these occasions, the canal was sought to be sited on the island, a few miles to the east of Pamban Railway Bridge. The old records show that long before these schemes were considered, another site which is situated on the main land a few miles to the west of Pamban Bridge had been recommended by Commander A.D. Taylor of the Indian Marine. Our local enquiries and investigation lead us to the conclusion that this site is the most suitable and we recommend accordingly. The distinguishing feature of a canal at this site will be clear from the following description given in the old records :—

> "The southern end was to start from 'Port Lorne' a natural harbour, a few miles down the coast from Mandapam, seven miles in length and 4¼ miles in breadth the greater part of which has a depth of 24 feet and for some considerable extent upto 30 feet deep, the deepest parts being 36 feet. It is well sheltered by the Musal and Muli Islands and reefs. Its entrance has only a depth of 15 feet but if this were deepened it would make the harbour a safe one for the anchorage of all vessels during the south-west monsoon".

The proposal made by Commander A.D. Taylor was turned down on the ground that the northern side is exposed to the North-east monsoon and would require special protective works; and for this reason, the cost was estimated at that time at 2 crores. Thereafter, the search for a low-cost-site took later investigators successively eastwards and this site was never considered again; even though the particular reason underlying its original rejection was later recognised to be of no great force. The North-east Monsoon in this area is far from being a formidable problem. From the point of view of protection of canal entrances, the Southern entrance is much more important than the northern entrance. The natural harbour described in the extract cited above is still there; its depths remain the same. The availability of such a natural protection is a great asset from the navigational point of view. It is a decisive consideration in favour of this site. There are others.

First.—The site is directly in line between Tuticorin and Palk Strait. It will therefore enable the fullest advantage being taken of saving in distance and time.

Secondly.—It will facilitate the location of a direct route lying entirely to the west of the Sethusamudram medial Line.

Thirdly.—The location of the canal to the west of the Island, on the mainland obviating the use of the vulnerable railway bridge at Pamban has its obvious advantages over a canal on the island to the east.

Fourthly.—The excavation will be much easier as the borings indicate the strata to consist almost entirely of sand. There is little sign of hard material.

Fifthly.—The scope for development (which will be opened up by the construction of a canal) will be far more important at the recommended site; because of its situation on the mainland and in the vicinity of a natural harbour.

18. *Need for and location of the Approach Channel to the Bay of Bengal (Middle Channel, Palk Straits).*—Though it was known that there were shoals at the entrance into the Bay of Bengal from Palk Bay, no provision was made in previous schemes for dredging a channel through these shoals. The reason was that deep water was (and is) available along the north and north-eastern coast of Celyon; and it was assumed that ships would take this passage. We do not consider this to be satisfactory. First, we consider it essential that there should be an unbroken National Sea-Way for India's Coastal trade; and the principal merit of the Sethusamudram Project is that it will bring into being such a National Sea-Way for the first time. This purpose will not be secured, if a part of the Sethusamudram Navigation route runs through the territorial waters of Ceylon.

Secondly, the full benefit of the saving in distance and time will not be secured. We propose, therefore, that an Approach Channel to the Bay of Bengal (Middle Channel, Palk Straits) should be dredged down to the requisite depth; and that this channel should be located in what is now referred to as the "middle channel" on the Admiralty Chart No. 68[a]. The proposed location of the Approach Channel is shown in Part A of Annexure I.

Two members of our Committee (Capt. J. R. Davies and Sri B. N. Chatterjee) inspected the area in which the channel is proposed to be located. They have satisfied themselves that there will be no special difficulties either in dredging or in maintaining the Channel. Stable conditions appear to prevail and sand movements are unlikely to be serious.

19. *Need for linking Sethusamudram Navigation Route with Tuticorin Port and Harbour.*—The Sethusamudram Navigation Route cannot be a complete alternative for the Round-Ceylon-Route unless it had on it a port and harbour which would provide the same facilities for ships using the route as the port and harbour at Colombo. Given this need, the obvious choice is Tuticorin. The earlier schemes ended in failure mainly because this fact was not recognised sufficiently clearly. The Tuticorin Harbour Development Scheme was abandoned in the course of execution because it was sanctioned on the basis that the entire cost of the scheme should be financed by a levy on the trade in the Port. This was found to be impracticable because the cost of cutting the hard rock in the harbour was necessarily high; while the net revenue realisable by the increase of traffic which could be counted on was relatively small. Our enquiries confirm that this is still the position. It is not possible to finance even the minimum requirements of improvement at Tuticorin unless it is recognised that such improvement makes a very real contribution to the development of national shipping and maritime trade and funds are therefore provided on that basis.

Our enquiries go to show that if the two schemes are integrated into a single project, the net revenue realisable from the Project will be sufficient to justify the initial capital outlay required. We have already pointed out that the development of the Tuticorin Port is a necessary part of the establishment of the Sethusamudram Navigation Route. That is why we consider it necessary to make provision, within an integrated Project, for the essential minimum of works required for linking the Port to the route.

20. *Limitation of route to ships with not more than 26 feet draught.*—The general level of depths naturally available in Palk Bay indicate the draught for which the Sethusamudram Navigation Route should be designed in the first instance. The deeper the draught, the larger the quantum of dredging and excavation which will be necessary. There is, therefore, a point beyond which the additional cost of dredging and excavation will not be justified by the increased number and tonnage of ships which may be expected to use the route. We observed (after a careful study of all the relevant data) that this draught should be fixed at 26 feet. The main canal, the approach channels to the canal and the Bay of Bengal approach channel (Middle Channel, Palk Straits) have

all been designed on this basis. This consideration does not however apply to the Tuticorin harbour. We think it necessary that the improvements to this harbour should be designed *from the outset*, so that the Port and Harbour could be used by all ships which at present use the Port and harbour of Cochin, Colombo and Madras. The canal and the canal lock have been designed to allow for further deepening, when necessary.

This completes our explanation of the more important features of our general approach to problems of design. We now proceed to give a brief description of the individual items of work together with the estimated cost of each item.

21. *Sethusamudram Canal.*—The Sethusamudram Canal is the central item of the Project. It will connect the Gulf of Mannar with Palk Bay and will be 5,400 yards long. It will be 32 feet deep and 150 feet wide at the bottom. The side slopes will be 1 : 4. The canal will cost 67 lakhs; at the rate of Re. 1/- per cubic yard. The canal is designed to permit TWO-WAY TRAFFIC. The excavated material will consist almost entirely of sand. It should be used in raising the general ground level of the Canal area, especially on the Western side.

22. *Sethusamudram Canal South Approach Channel.*—Before entering the canal it will be necessary to enter the natural harbour referred to already. The approach channel will, therefore, consist of two sections, of which the outer section will provide access from the Gulf of Mannar through the reef and the inner section will provide the approach to the canal entrance.

(*i*) *Outer Section.*—This section will be 870 yards long, 250 yards wide and 32 feet deep. It is expected to cost Rs. 26 lakhs at the rate of Rs. 3/- per cubic yard. The excavated material will most probably consist of soft coral rock. It should be carried to the shore in the first instance; and later transported through the canal to the northern entrance and used to form a protective work at that entrance.

(*ii*) The inner section of the South Approach channel will be 9,270 yards long. The bottom width of the channel will vary from 150 yards at the southern end to 50 yards near the canal entrance. The side slopes of the channel will be 1 : 4. This channel will cost Rs. 53 lakhs at the rate of Re. 1-4-0 per cubic yard. The dredged material will consist almost entirely of sand and mud. It should be used (if required) in the manner indicated in para 21 above. Otherwise, it should be taken out beyond the coral reef cut and dumped in the deep sea.

23. *Sethusamudram Canal North Approach Channel.*—This channel will connect the north entrance of the Sethusamudram canal to deep water in Palk Bay. It will have the same section as the south Approach Channel; but will be 7,100 yards long. The cost of this channel will be Rs. 49 lakhs at the rate of Re. 1-4-0 per cubic yard. It includes, however, provision for a rough stone protective work designed to enable ships to shape up in calm water before entering the canal. The stone for this work will be available from the coral reef cut at the outer section of the South Approach Channel, as indicated already. The sand and mud dredged from this channel should be discharged by a pipe line, to the shore and used for levelling up the land area.

24. *Sethusamudram Canal Lock.*—It is necessary that the canal should be provided with a lock; and this represents a considerable addition to its cost. The expense is unavoidable, in the interest of navigational convenience and safety. During the North-east Monsoon, the sea level in Palk Bay is likely to be higher than in the Gulf of Mannar and the reverse is likely to be the case during the South-west Monsoon. In the absence of a lock, there would be a strong current which will erode the banks of the canal, besides hindering navigation. We are of opinion that one lock will be sufficient; and it should be located near the north entrance. Though the canal will have a depth of only 32 feet the lock will be constructed with 36 feet depth. This is with an eye to future requirements when the canal may be deepened to permit the passage of ships with deeper draught. The lock will be 1,320 feet long and 110 feet wide and is estimated to cost Rs. 120 lakhs.

25. *Sethusamudram Canal Bridge.*—The Sethusamudram Canal will cut the Southern Railway. It is likely that after the canal is constructed, the main railway line will terminate to its west. But a light shuttle service will have to be maintained from its east bank for the convenience of pilgrims. A Railway connection will have to be maintained over the canal, in order to provide for occasional transfer of rolling stock. Further there is also a National Highway which is proposed to be carried forward to Dhanushkodi during the Second Five Year Plan. It will be necessary therefore to make provision for a suitable movable bridge across the canal to carry both the road and the railway. This bridge will cost Rs. 22 lakhs.

26. *Bay of Bengal Approach Channel.* (*Middle Channel, Palk Straits*).—The need for this channel has been explained already. It will be 24,080 yards long and 32 feet deep. Much of this depth is already available; and the amount to be dredged will only be about 3 feet 9 inches in depth on the average over the above length. The channel will cost Rs. 77 lakhs, at Re. 1/- per cubic yard. The dredged materials will be mud and sand; and should be taken out to a distance of five miles and dumped in the sea.

27. *Tuticorin Harbour Approach Channel.*—According to the Tuticorin Harbour Preliminary Investigation Report, Sri B. N. Chatterjee had recommended an apporach channel about 4 miles long which was estimated to cost Rs. 1½ crores. The Scheme included, in addition, the provision of three berths estimated to cost Rs. 3 crores. For the reasons explained already, we found it necessary to limit the cost of all improvements to be undertaken at Tuticorin Port and Harbour as part of the integrated Project, so that the initial capital outlay on the entire Project would be justified by the net revenue return. In effect, this meant the allocation to Tuticorin of about Rs. 1½ crores (exclusive of the cost of equipment and organisation charged to the Project as a whole).

Sri B. N. Chatterjee was limited by his terms of reference to a 20 feet Port. He had, in consequence designed the channel with a width of 200 feet and depth of 27 feet. It is necessary, however, on our view of the relationship of the Tuticorin Port and Harbour to the integrated Project that they should be so improved as to accommodate ships of much deeper draught, from the outset. In other words, a wider and deeper channel is necessary. Given the financial limitation mentioned above, it follows that the channel must be shorter.

The old records show that a scheme of improvements based on a shorter channel was feasible; provided it was located about 2 miles to the south. This appeared to be a possible solution. We considered it carefully; but decided against it for the following reasons:—

First.—It was calculated to bring about a bifurcation of the line of development of the port to which the local people of Tuticorin raised a natural objection.

Secondly.—From the navigational point of view, it is certainly less convenient and probably somewhat hazardous, unless protective works involving appreciable cost were undertaken.

Thirdly.—A study of the history of sand movements in and around the port indicates that a channel located according to the old alignment would encounter sand trouble and entail a considerable amount of maintenance dredging.

For these reasons, we consider it necessary to adhere to the location of the channel in the neighbourhood of the line recommended in Sri B. N. Chatterjee's Report. Careful study of local conditions brought to our notice the existence of what is described as "Seltive Reef". This reef is situated at a point which is at the same time near enough to deep water and is also approachable from land along very shallow water. The solution to the problem therefore lay in limiting the approach channel from deep water to "Seltive Reef" and building up a pier there with a causeway connecting it to the land along the line of shallow water, and carrying a road and railway. The proposed design is indicated clearly in Drawing No. 10 of Annexure 'II'. We attach considerable importance to it because it provides the solution for all the problems which were, in fact, responsible for the abandonment of the old scheme.

The channel so designed will be about 5,400 yards long, 100 yards wide and 36 feet in depth. It will cost Rs. 102 lakhs at Rs. 3/- per cubic yard. A large proportion of the dredged materials will consist of conglomerate sand stone and lime-stone. The materials should be used on building up the pier and causeway.

28. *Tuticorin Harbour—Anchorage, Pier and Causeway.*—The proposal is that at the end of the approach channel referred to above, an anchorage should also be provided. The pier and causeway will be designed so as to be broad enough to accommodate both a road and a railway siding. A sum of Rs. 60 lakhs is proposed to be provided for the anchorage, pier and causeway (including the road and railway). This will be adequate for dredging an anchorage which would be sufficiently large to serve also as a Turning Basin. The materials dredged for the anchorage should be used for the pier. This will complete the bare minimum of works necessary for linking the port and harbour with the Sethusamudram Navigation Route. When this work is carried out, it will prove to be the starting point of a programme of continuous further development of the port and harbour. Land reclamation will be undertaken continuously so as to provide reclaimed land of considerable value to the Port on either side of the causeway. This should come about concurrently with the development of the trade of the port.

29. *Project Headquarters—Lands and Buildings.*—Lands and buildings will be necessary in the neighbourhood of the Sethusamudram Canal for the location of the Project headquarters. Buildings will have to be constructed for offices, staff quarters, hospital, workshop, etc. Electricity and water supply will have to be provided. Preliminary surveys will have to be undertaken for settling details of lay-out and design of each individual item, before it is executed. For all these purposes, a sum of Rs. 57 lakhs is provided.

While on this point, we would like to invite attention to the fact that the Mandapam Emigration Camp has ceased to be necessary for the purpose for which it is originally intended. It will be very suitable for the location of the Project headquarters, administrative offices and other connected uses. Again there is a dry dock and a marine workshop belonging to the Southern Railway at Mandapam. They will be needed for the project. If the Dhanushkodi—Talaimannar Ferry service is discontinued, they will be surplus to Railway requirements. These matters may be considered at the appropriate stage.

30. *Dredgers*—A full account of the different types of dredgers which can be used in operations of this kind and their advantages and dis-advantages will be found in the Tuticorin Harbour (Preliminary) Investigation Report. We recommend the use of a dipper dredger and a rock-breaker for cutting the Coral reef and dredging the Canal-approach-channel as well as for cutting hard rock and dredging the Tuticorin Harbour approach channel and Anchorage.

For all other dredging work, it will be necessary to provide two large suction (cutter hopper) Dredgers. A specification of these dredgers is included among the statements in Annexure II.

A sum of Rs. 150 lakhs will be required for the pucrchase of these dredgers. When the construction of the project is completed, both suction (cutter hopper) dredgers will be needed for the maintenance dredging of the entire Sethusamudram Navigation Route. The dipper dredger and rock breaker will be surplus to requirements. The residual value of the dredger and the rock breaker would afford credit to the capital cost.

In this connection we understand that a second-hand dipper dredger and rock breaker happen to be available with the Bombay Port Trust. It is possible that they can be reconditioned and made use of, in which case there would be an appreciable saving in expenditure and the work can be started quickly. We suggest that consideration be given to this possibility.

31. *Other Project Machinery, Vessels and Navigational Aids.*—For a full statement of these requirements, attention is invited to statement No. 3 (Annexure II). A sum of Rs. 127 lakhs will be needed for this purpose. They include Rs. 50 lakhs worth of earth moving machinery and other land equipment, which will be surplus to requirements after the Project is executed. The residual value of such equipment will also afford credit to the Capital cost.

32. *Project Establishment.*—A sum of Rs. 40 lakhs is proposed to be provided on account of Project establishment, at the rate of 6% on the cost of works.

33. *Provision for unforeseen contingencies.*—We have endeavoured to foresee and make adequate provision specifically for all items of works which are likely to be necessary. However, in a Project of this nature, it is necessary to make adequate provision for unforeseen contingencies. We propose to provide Rs. 48 lakhs for this purpose at the rate of 5% on the overall cost.

34. *Estimate of total cost of Project—Initial Capital outlay.*—We have completed our description of all items for which provision must be made and we are led to the value of our estimate of the total cost of the Project at Rs. 998 lakhs as shown below:—

SETHUSAMUDRAM PROJECT COMMITTEE

Abstract estimate of cost

		(Rupees in lakhs)
I.	Sethusamudram Canal	67
II.	Sethusamudram Canal-South Approach Channel (outer section)	26
III.	Sethusamudram Canal-South Approach Channel (Inner section)	53
IV.	Sethusamudram Canal-North Approach Channel	49
V.	Sethusamudram Canal Lock	120
VI.	Sethusamudram Canal Bridge	22
VII.	Bay of Bengal Approach Channel	77
VIII.	Tuticorin Harbour Approach Channel	102
IX.	Tuticorin Harbour-Anchorage and pier, including railway sidings	60
X.	Sethusamudram Project Headquarters Land and Buildings	57
XI.	Dredgers	150
XII.	Sethusamudram Project Vessels, Machinery and Navigation Aids	127
XIII.	Sethusamudram Project Establishment	40
XIV.	Unforeseen contingencies	48
	TOTAL	998

35. *Order of carrying out Project Works and estimate of time.*—In making provision for dredgers and other equipment, our aim has been to secure that the work may be completed within three years of the date on which the dredgers and other equipments are made available at site. If ready-made equipment happens to be available, time can be saved but it will be probably necessary in any case to allow about a year for the ordering, manufacture, transport and delivery of machinery or vessels. This time will not be wasted. It would be needed for setting up the Project Headquarters, carrying out preliminary surveys, acquiring lands and constructing buildings. The excavation of Sethusamudram canal should be taken up as the first item for execution. The necessary equipment can, presumably be procured quickly. The construction of the lock entrance should also be taken in hand, along with land operations on the canal, and proceeded with expeditiously. As soon as the dipper dredger and rock breaker arrive, they should be set to work on the cutting of the coral reef at the outer section of the south approach channel of the Sethusamudram Canal. As soon as this is completed, the dredger and rock breaker should proceed to Tuticorin and cut the approach channel and the anchorage.

As soon as the suction cutter hopper dredgers arrive, one should be put to work on the North Approach Channel of the Sethusamudram Canal and another on the inner section of the South Approach Channel. So much of the canal itself, as cannot be excavated by land operations will then be dredged, the lock entrance having been completed before hand.

The two dredgers should then proceed to the Bay of Bengal approach channel and complete the work there. The construction of the pier at Tuticorin will proceed simultaneously with the dredging of the approach channel and the anchorage.

If the sanction to the Project is accorded within the first year of the Second Five-Year Plan, we believe it would be found possible to complete the entire Project before the end of the Second Five-Year Plan Period. Naturally, it is difficult to assess the time factor involved in cutting coral reef and work under the sea; but there is no doubt that the dredgers of the type recommended will be able to cut them and in our opinion, they should be able to cut them within the time indicated.

36. *Estimate of recurring annual charges of maintenance.*—We have taken stock of the probable requirements of annual maintenance of all the works mentioned above, and in our opinion, an annual expenditure of Rs. 26 lakhs should be sufficient for the purpose. The break-up of this estimated total is shown below:—

A. Sethusamudram Navigation Route

		(Rs. in lakhs)
I.	Administration and Accounts	1·50
II.	Deputy Conservator, Pilotage service and Communications	1·75
III.	Medical, Security and other contingencies	1·75
IV.	Maintenace, Dredging	5·50
V.	Maintenance-Vessels	4·75
VI.	Maintenance-Lock	0·75
VII.	Workshop	1·50
VIII.	General maintenance of buildings electrical works, water supply and sanitary fittings, roads, etc.	2·00
		19·50
IX.	Tuticorin Harbour Approach Channel	2·00
X.	Depreciation	4·50
	TOTAL	26·00

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We should add that so far as the navigational aids are concerned, specification of requirements is furnished as part 'C' to Annexure 'I'. There is a distinction between "General aids" (the provision and maintenance of which is the responsibility of the Light House Department, Ministry of Transport, Government of India) and "Local aids". Our estimate of maintenance expenditure includes provision only for the latter.

Section III—Estimates of Traffic and Revenue

37. *Basic Data.*—We have obtained particulars regarding every steamer which called at the Port of Madras during the three calendar years 1952, 1953 and 1954. These particulars include the gross tonnage, net tonnage, draught on arrival as well as departure, port of origin, next port of call and ultimate destination. We have obtained similar details in identical forms from Calcutta Port for the three financial years 1952-53, 1953-54 and 1954-55. These are the basic data on which our estimates of traffic and revenue have been framed. For purposes of framing estimates of traffic and revenue, a common base period of 30 months from July 1952 to December 1954 was adopted.

38. *Combined analysis.*—The total number of ships which entered either or both the ports during the base period was 2,888. Their gross registered tonnage was 186 lakhs of tons; and net registered tonnage was 110 lakhs of tons.

Out of this total, 1,284 ships with a total gross tonnage of 77 lakhs of tons and net tonnage of 46 lakhs of tons entered Madras Port only. 985 ships with a gross tonnage of 67 lakhs of tons and net tonnage of 39 lakhs of tons entered both Madras and Calcutta Ports. 619 ships with gross tonnage of 42 lakhs of tons and net tonnage of 25 lakhs entered Calcutta Port only.

Of all these ships, those which had a draught of not less than 26 feet either while entering or when leaving any port were excluded. The number of ships thus excluded was 390, with gross tonnage of 30 lakhs of tons and net tonnage of 18 lakhs of tons. Among these 390 ships, there were 244 which entered Madras Port, 128 which entered both Madras and Calcutta Ports and 18 which entered Calcutta Port only.

Again, there are certain ships which are ascertained to have entered the Bay of Bengal from eastern ports and returned to eastern ports. (Such ports are Singapore, Hongkong or Japanese ports or Australian Ports etc.). The total number of such ships is 474, of which 411 entered Madras Port only, 32 at both Madras and Calcutta Ports and 31 at Calcutta Port only. Their gross tonnage was 23 lakhs of tons and net tonnage a little over 13 lakhs of tons.

The remaining ships fall into two separate groups. Group A consists of ships which have come from and also returned to western ports. The total number of such ships is 1,175, of which 667 entered Madras and Calcutta Ports, 426 entered Calcutta Port only and 82 ships Madras Port only. Their gross tonnage was 82 lakhs of tons and net tonnage was a little over 48 lakhs. The remaining ships constitute Group B. They include ships which entered the Bay of Bengal from eastern ports and proceeded therefrom to western ports; and ships which entered the Bay of Bengal from Western ports and thereafter proceeded to eastern ports. The total number of ships of Group B was 849, of which 547 entered Madras port only, 158 entered both Madras and Calcutta Ports and 144 touched at Calcutta Port. Their gross tonnage was a little over 50 lakhs and net tonnage 30 lakhs.

In view of what has been stated in the proceeding sub-paragraph, it is a fair assumption that if the Sethusamudram Navigation Route has been open during the last few years, all ships of Group A would have passed through the Canal twice, while all ships of Group B would have passed through the canal once. [On this basis (and after striking the average for a twelve month period) the following result is arrived at :—]

Having regard to the actual movement of shipping and trade in the Bay of Bengal, the average annual traffic of ships which would have passed through the Sethusamudram Canal (had the canal been in existence during the middle of the first Five-Year Plan Period) may be estimated as below:—

		No. of ships	Gross tonnage	Net tonnage
July 1952 to December 1954	2A	2,350	1,63,00,000	97,00,000
	B	849	50,00,000	30,00,000
TOTAL		3,199	2,13,00,000	1,27,00,000
Average for 12 months at 2/5 of the total		1,280	85,00,000	51,00,000

NOTE.—In this estimate of traffic, every ship is counted each time she transits the canal.

39. *Saving in distance by Sethusamudram Navigation Route.*—The extent to which a saving in distance will be gained by ships, as a result of using Sethusamudram Navigation Route, is explained below:—

The saving in respect of ships arriving directly from non-Indian ports from the west may be computed with reference to distances from Muttum Point (close westward of Cape Comorin) to ports in the Bay of Bengal. The saving involved is 362 miles to Madras, 304 miles to Vizagapatnam, 265 miles to Calcutta, 220 miles to Chittagong and 119 miles to Rangoon. Even in respect of Singapore there is a saving of 42 miles. The distance from Tuticorin to Madras *via* Sethusamudram Navigation Route will be 316 miles. The distance by the Round-Ceylon-Route is 750 miles. The saving is 434 miles or 58%. Similar saving for a coastal ship voyaging between Cochin-Madras and touching Tuticorin enroute is 44%. For a voyage between Tuticorin and Calcutta, the saving is 26%; while for a voyage from Bombay to Calcutta (touching Tuticorin *en route*) the saving is 16%.

40. *Saving of Time.*—The speed of ships naturally varies with consequent variation in the time taken on passage at sea. Generally, it may be assumed, that every ship which uses the Sethusamudram Navigation Route will save at least one day and probably as much as 1½ days, as compared with the present Round-Ceylon-Route. In computing this saving of time, we have taken into account the canal transit.

A further saving of time will arise with the development of a deep water port at Tuticorin where adequate bunkering and water facilities will be made available.

It is reasonable, therefore, to reckon on a saving of at least one day for all ships. So far, as ships engaged in the coastal trade of India are concerned, this saving of time and distance at sea will amount to a substantial reduction, say, 20 per cent on the average.

41. *Probable increase of traffic over a Ten-year-period.*—We expect the Sethusamudram canal to be completed shortly before the end of the Second Five-Year Plan Period. It will be necessary to allow two or three years for the canal traffic to develop and stabilise. It is necessary to arrive at an estimate of the increase in canal traffic likely to occur before the middle of the Third Five-Year Plan Period. In framing an estimate of probable increase, it is necessary to distinguish between two different causes of such increase.

First—An increase in the actual number of ships and their tonnage irrespective of increase in the average frequency of use of the canal by each ship during every year.

Secondly—An increase in the average frequency of such use consequent on the quicker turnround of ships which would become possible by the execution of the project. The canal traffic can increase for this reason, even if there were no physical increase in the number of ships or their tonnage.

For reasons which we explain presently, it is reasonable to add 21 per cent over the estimate furnished in para 38 on account of the first of these two factors, *viz.*, physical increase of available shipping.

It is also reasonable to add another 5 per cent on account of quicker turnround of ships. In the result, we estimate the average annual traffic of ships which may be expected to pass through the Sethusamudram Canal round about the middle of the Third Five-Year-Plan Period as below:—

No. of ships.	Gross tonnage	Net tonnage
1,613	1,07,00,000	64,00,000

Note—In this estimate of traffic, every ship is counted each time she transits the canal.

42. *Basis for estimation of percentages of increase.*—The National Five-Year Plan makes provision for a planned increase of India's shipping. We understand that the target of gross registered tonnage of Indian shipping for the end of the First Five-Year Plan Period is 6,00,000 tons. The actual tonnage was 4,50,000 during the base period. This has since increased. The balance tonnage is on order and under construction. It is also reported that the target for the end of Second Five-Year Plan period has been settled at 9,00,000 tons. We assume that this target will be attained and the increased tonnage of shipping will be in actual operation before the middle of the Third Five-Year Plan Period.

It follows that that part of the estimated canal traffic which is represented by Indian shipping will be increased by at least one hundred per cent in ten years.

An analysis of the data received from Ports of Madras and Calcutta shows that Indian Shipping represents 21 per cent of the estimated canal traffic. It follows (other things being equal) that the estimate furnished in para 38 above should be increased by 21 per cent in order to allow for physical increase of shipping.

It has been noted already in para 40 above that the reduction of distance and time at Sea consequent on the execution of the Project will be of the order of 20 per cent, so far as coastal shipping is concerned. Assuming that coastwise trade accounts for approximately one-third of the Canal traffic, and allowing for the time taken at ports, we estimate the increase of Canal traffic, on this ground, at 5 per cent. Hence the conclusion that a further increase of canal traffic by 26 per cent can be anticipated.

43. *Availability of cargo.*—We have considered the point whether the anticipated increase of Indian Shipping may be offset by some decrease of non-Indian shipping. In our opinion, such a contingency is very unlikely in the context of planned development. In general, industrial as well as agricultural production has been moving up under the stimulus of the National Five-Year Plans. The demand for rail transport is steadily on the increase. We understand, in particular, that there is a large unsatisfied demand for the movement of coal, a commodity, of which, the availability of assured supply in adequate quantities in all parts of the country is an essential condition of further development. It is inevitable that an appreciable part of the increased demand will have to be transferred from Railways to other forms of transport, especially coastal shipping. The problems involved in Rail-Sea Co-ordination are under active study at the present moment by a Committee appointed for this purpose. We have no doubt that the problems will be solved without undue delay and that as and when the availability of coastal shipping is increased, the cargo will be there to be moved. Our estimate of increased traffic can, in our opinion, be realised by a planned increase of coast-wise trade, independently of changes in the volume of foreign trade.

44. *Rate of Canal Dues—Relevant Considerations.*—We may now proceed to estimate the revenue receipts obtainable by canal dues. To this end, it is necessary to settle the rate of charge to be levied on ships which will use the Sethusamudram Navigation Route. We have given careful consideration to this subject and our conclusion is that a standard rate of Re. 1/- per net registered ton would be,a fair charge. The considerations which have led us to this conclusion are set out below:—

(*i*) Nearly 50 years ago the South Indian Railway Company framed a scheme for the construction of the Rameswaram Ship Canal and at that time adopted 9 annas per gross registered ton as the charge to be levied. As (on an average) net registered tonnage may be taken as about 3/5th of gross registered tonnage, this was equivalent to levying canal dues at the rate of 15 annas per net ton. Thirty years ago, when the Scheme was revived and considered by the Government of Madras, the Engineer who made the detailed investigation proposed the same rate, *viz.*, 9 annas per gross ton. His proposals were scrutinised by an *ad hoc* committee at Tuticorin, which consisted of representatives of all interests concerned. This Committee took the view that 9 annas per gross ton was too high. It proposed, instead, 9 annas per net ton as a fair charge. The Committee estimated that on an average every ship (of 3000 tons NET) would save 2000 rupees per voyage. The actual saving in cost was ten annas eight pies per net ton. The Committee allowed a deduction (of one anna and eight pies per net ton) as a margin of inducement to ship owners, over and above the increased profit attributable to the quicker turn round of ships. Hence its conclusion that there would be no difficulty in realising 9 annas per net ton as canal dues.

(*ii*) During the last 30 years, the Capital cost of ships and their operational costs have risen steeply. At the same time, however, the speed of ships has increased appreciably. After making due allowance for this factor *it would be reasonable to conclude that the saving in cost attributable to the shortened sea route would be not less than twice the saving which was estimated 30 years ago.* The cost, at that time, was estimated at 10 annas eight pies per net ton. It may now be taken to be Rs. 1-5-0 per net ton.

(*iii*) We have received specific information regarding voyage costs of different types of ships owned by two Indian Shipping Companies. The ships operated by these companies are, we consider typical of the most efficient vessels operating at the least cost. The general level of costs is probably higher. The average daily cost per Net Registered ton is Rs. 1-5-0 according to the returns furnished by these companies. For these reasons we feel no doubt that the rate proposed by us one rupee per net registered ton is a fair minimum charge. We do not recommend a higher rate for the reason that it is necessary to provide adequate inducement to use the canal.

45. *Review of traffic at Tuticorin Port-Number and Tonnage of ships.*—The Port of Tuticorin has passed through vicissitudes of fortune. As long ago as 1910, over 700 Steamers (13 lakhs Net Registered Ton) used to enter the Port. From 1909 to August 1914, there used to be a daily service of steamers to and from Colombo. From August 1914 till 1918, this service was reduced to one steamer in every three days. From 1918 onwards, the service was further reduced. At about the same time, the Indo-Ceylon rail route came into being, with the Dhanushkodi-Talaimannar Railway Service. As a result, there was a steep fall in the arrival of steamers at Tuticorin. The lowest level was reached in 1918-1919 with 116 steamers. Thereafter traffic recovered gradually and the number of steamers reached the peak figure of 588 during 1935-36 (17 lakhs Net Registered Ton). Then the traffic began to decline and a sharp fall occurred during World War II. The lowest level was touched in 1945-46 when the number of steamers was reduced to 111 (2 lakhs Net Registered ton). After that year, a rapid process of recovery set in. The number of steamers entering the port rose steadily from year to year and passed the 500 mark during 1952-53 and 1953-54. A slight fall occurred in 1954-55. The present position is that about 500 ships enter the port annually. It will be observed that the total number is not far short of the pre-war figure. The aggregate tonnage (approximately 7 lakhs of tons) is very much smaller than it used to be. This is due to the fact that small motor vessels plying between Tuticorin and Colombo account for a sizable proportion of the present total. Thus, out of 55 vessels which entered Tuticorin during March, 1955, no less than 32 entries were made by 7 vessels with an aggregate tonnage of only 5,095.

46. *Review of Traffic at Tuticorin Port.—Import and Export of Cargo.*—Before World War I, the total volume of imports and exports at this port used to be round about four lakhs of tons (exports exceeding imports by a small margin). The trade declined during the World War I. Figures relating to subsequent changes are not readily available. The statistics of five years from 1949-50 to 1953-54 indicate that the total volume of imports and exports has been fairly steady round about a total of five lakhs of tons.

Thus, the recovery in respect of cargo handled at the port has been somewhat better than the recovery in the number and tonnage of ships entering the port.

During 1954-55, 2.9 lakhs of tons of cargo were exported and 2.3 lakhs of tons were imported. The import trade is almost entirely limited to coastal trade; and coal is the principal item of import, accounting for 1.5 lakhs of tons. The export trade consists of 1.8 lakhs of tons of coastal trade; 0.8 lakhs of tons of trade with Ceylon; and 0.4 lakhs of tons of trade with other non-Indian countries. The principal item of export is salt, (1.2 lakhs of tons). Cement is the next most important item of export with a little less than 70,000 tons (about equally distributed between coastal trade, Indo-Ceylon trade and other foreign trade).

47. *Prospects for development of traffic at Tuticorin Port.*—(*i*) The improvements which we have recommended for Tuticorin Port will enable large ocean-going vessels to enter the harbour. As the Port will be on the Sethusamudram navigation route, the number and tonnage of ships entering the Port can be expected to increase progressively.

(*ii*) There is definite information before us indicating that exports of cement are likely to increase. A cement factory in the hinterland is expected to instal a second plant, early in June-July of this year, and daily production is expected to increase by about 700 tons. As the local market is already supplied adequately a large proportion of the new production is expected to be exported to Calcutta and/or foreign markets. We estimate the prospective increase of export of cement at about 150,000 tons.

(*iii*) The possibilities of coastwise movement of coal have been closely reviewed and full particulars are given in Appendix D. Tuticorin is likely to get a share of this increase, probably not less than 30,000 tons.

(*iv*) Salt is produced in the vicinity of the port; and it is already the most important item of export. When port facilities are improved, it is likely that the production and export of salt will increase.

(*v*) We have been informed by the oil companies that if a deep-water harbour is provided, then they would make arrangements for importing and distributing oil and oil products.

(*vi*) We have been furnished with particulars of a number of different commodities of which the production and trade can be expected to develop gradually if ocean-going ships began to call regularly at this port.

(*vii*) We have also been informed that there is a proposal to set up a Soda Ash factory near Tuticorin with a productive capacity of 200 to 300 tons per day. If this project materialises, there will be a considerable addition to the trade not only on account of the export of soda ash but also on account of the import of coal which will be necessary for the factory.

(*viii*) The entire area served by the metre-gauge railway in Madras is accessible both from Tuticorin and Madras. Owing to lack of facilities at Tuticorin, it is said that there is a fair amount of traffic which is at present carried by the Railway between Madras and the vicinity of Tuticorin. If Tuticorin Port is improved this situation is likely to get corrected, with some improvement of trade at Tuticorin and consequent relief for the Port of Madras and Southern Railway.

In general, experience shows that the development of trade does follow the improvement of port facilities.

Taking all these circumstances into account, we consider that the aggregate tonnage of cargo imported and exported at this port will increase from its present level of five lakhs of tons to about eight lakhs of tons, if the Port is improved *and* the Sethusamudram Navigation Route is opened in the manner recommended by us. Our estimate of eight lakhs of tons relates to the middle of the Third Five-Year Plan period. We expect the process of increase will continue progressively.

48. *Tuticorin Port Revenue Receipts.—Present and Prospective.*—On an average of three years ending 1953-54, the revenue receipts of the port amount to Rs. 6.6 lakhs. At the same time, the average volume of import and export of cargo was 4.9 lakhs of tons. Thus, on an average, the port earned Rs. 1-6-0 per ton imported and exported. An increase in this average rate may be fairly expected, (along with the increased volume of trade) if the port is improved. Caution is however necessary in assessing the amount of such increase. Regard should be had to the difference between the long term and short term aspects of the development of the port. We frame our revenue estimate with reference to conditions likely to prevail immediately after the project is executed. At that stage, the immediate advantage which will be derived by the trade as a result of the improvements we have proposed will merely be to enable part of the cargo to be loaded directly on to the rail thereby avoiding lighterage charges as well as the double handling at present involved. In respect of the remaining part of the cargo, however, lighterage will still continue, though the distance will be halved and loading and unloading will take place in calm water inside the harbour instead of the open roadstead as at present. But this will be only the beginning. From year to year, as reclamation of land progresses, and more berths are constructed and other facilities are provided, the value of the service rendered by the port will increase and consequently also the average revenue realised per ton of cargo will increase. We do not, however, take these longer term prospects into account in framing revenue estimates of the present project. As the rates at present authorised for lighterage are in the neighbourhood of Rs. 1-4-0 per ton, we propose to value the services rendered to trade by the particular improvements which we have recommended only at an average rate of Re. 0-12-0 per ton on all cargo landed or shipped. On this basis, we estimate the increased revenue realisable at Tuticorin shortly after the execution of the Project *to be six lakhs per annum.*

49. *Gross Revenue Receipts of Integrated Project.*—We have already estimated the gross revenue realisable by canal dues at 64 lakhs per annum. *Thus the total gross revenue receipts attributable to the integrated project as a whole is estimated at 70 lakhs per annum.*

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Section IV—Direct Financial Return

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50. *Direct Financial Return.*—Our estimate of gross revenue is 70 lakhs per annum. Our estimate of the annual recurring charges of maintenance is 26 lakhs per annum, vide paragraph 36. The net revenue return is, therefore, 44 lakhs per annum. The initial capital outlay has been estimated at 998 lakhs, vide paragraph 34. We conclude, therefore, that the direct financial return on the initial capital outlay will be 4.4 per cent per annum.

51. *Margin of safety in estimates.*—In arriving at this conclusion, we have endeavoured as far as possible to secure that the cost is not under-estimated and the revenue return is not over-estimated.

(*i*) Thus, we have allowed Rs. 1-4-0 per cubic yard for dredging sand and mud in the approach channels on either side of the canal and Re. 1/- per cubic yard in the Bay of Bengal approach channel. In arriving at this figure, we have taken into account the actuals of similar dredging in Cochin. They were in the neighbourhood of 12 annas per cubic yard during the last two years and 15 annas per cubic yard earlier. It is likely that there is a margin for saving in this provision; more especially having regard to the intensive nature of the operations and large volume of dredging involved in the Project.

(*ii*) Rs. 3/- per cubic yard has been estimated as the rate for dredging (involving rock-cutting) at Tuticorin. This was arrived at by Sri B. N. Chatterjee after careful computation with reference to recent experience in foreign countries. We have assumed the same rate for the coral reef cut in the South Approach Channel to the Sethusamudram Canal; though it seemed possible (judging from the appearance of coral observed by us in the vicinity) that the cutting might be easier.

(*iii*) As already mentioned, we have provided 48 lakhs for unforeseen contingencies.

(*iv*) There is a considerable amount of residual value of equipment, which will become surplus to requirements after the project is executed. We have allowed no credit for this residual value in estimating the capital outlay on which the rate of return has been computed.

(*v*) Our estimate of canal traffic is based on a careful enumeration of ships which entered the ports of Madras and Calcutta during the base period. In this process, we have excluded many ships which in practice, would probably form part of the canal traffic. Thus, any ship which had a 26 feet draught either in arrival or on departure at either of the two ports has been excluded. It is reasonable to suppose that many such ships would, in fact, use the canal by suitable adjustment of their load. Further, we have taken no account of ships which entered the Bay of Bengal ports during the base period, other than Madras and Calcutta.

(*vi*) We have also based our estimate of development of traffic entirely with reference to the Indian Shipping and coastwise trade. We have made no assumption regarding non-Indian shipping and foreign trade except that they are unlikely to diminish.

(*vii*) Again our estimates regarding the development of traffic are related to the middle of the Third Five-Year Plan Period. In a project of this nature and magnitude, it would be reasonable and proper to take into account the development likely to occur over much longer period after the completion of the project. There can be little doubt that the development of canal traffic will not stop at 64 lakhs of net registered tons; and the development of Tuticorin trade will not stop at 8 lakhs of tons. They will increase progressively beyond these limits, as the maritime development of India gets under way.

(*viii*) Similarly, our estimates of gross revenue rates—one rupee per net registered ton for canal traffic and twelve annas per ton on Tuticorin trade—relate only to the Third Five-Year Plan Period. In the long run, they will no doubt be exceeded.

We are mentioning all these circumstances in order to indicate that our estimate of net return *viz.* 4.4 per cent per annum is not unduly optimistic; it may be regarded as the minimum realisable.

52. *Financial criterion.*—In the old days, schemes of this kind were required to yield a net revenue return on capital outlay which was sufficient not merely to meet the interest charges but also to provide for amortisation of the capital. It is well known that now-a-days there are scarcely any projects which can yield a return of this nature. A Project has to be classed as "productive" with reference broadly to the contribution it makes to the development of the national economy. A Project, which may be classed as "productive" in this sense, may or may not be also "remunerative". A Project may be classed as "remmunerative", if it can be relied on to yield a direct financial return, which is sufficient to exceed the interest charges on the capital outlay—whether or not the excess is sufficient to provide for amortisation also.

We are satisfied that the integrated Project which we have described in this report is both productive and remunerative. We recommend its acceptance and execution accordingly.

Section V—Answers to Terms of Reference

53. Answers to Terms of Reference.—Our Terms of Reference are reproduced below together with our answers thereto: –

(*a*) What is the extent to which shipping in general is likely to benefit by, and in practice to take advantage of, the shortened sea route *via* the Sethusamudram Passage ?	(*a*) If the Sethusamudram Project is designed and executed on the lines recommended by us, and if the charges levied on ships were also fixed in the manner recommended by us, we estimate that the number of ships using Sethusamudram Navigation Route will be 1,613 per annum. The aggregate total tonnage of shipping using the Canal each year will be approximately 107 lakhs of G. R. T. or 64 lakhs of N. R. T. The benefit derived by such shipping will be as follows :— (*i*) A saving in distance upto a maximum of 362 miles ; and consequently a saving in the time of voyage of a day or a day and a half ; and (*ii*) A more sheltered passage throughout the year.
(*b*) Would the advantages likely to be secured be commensurate with the expenditure involved ?	(*b*) We are satisfied that the advantages likely to be secured will be commensurate with the expenditure involved.
(*c*) What are the traffic prospects of the Tuticorin Port during the next decade :— (*i*) if the Sethusamudram passage is provided ; and (*ii*) if the Sethusamudram passage is not provided.	(*c*) (*i*) Provided the Sethusamudram Navigation Route is opened and the Tuticorin Port is improved in the manner recommended by us, we estimate the total tonnage of cargo imported and exported in Tuticori Port to be of the order of 8 lakhs of tons and is likely progressively to increase. (*c*) (*ii*) In the event of the Sethusamudram Navigation Route not being provided, any significant increase is unlikely so long as the Port is not developed to take ships upto 30 feet in draught. If the Port is developed to take ships upto 30 feet draught, in the absence of a Sethusamudram Navigation Route, it is probable that there would be a modest increase in the trade, say, of the order of one or two lakhs of tons per year, and there would also be a corresponding increase in the number and size of ships calling at the port provided bunkering and watering facilities are made available.
(*d*) In the light of the traffic assessment, should the Tuticorin Development Project be proceeded with ?	(*d*) Yes.
If so, what should be the timing :— (*i*) immediately by itself and independently of the Sethusamudram Project ; (*ii*) simultaneously with the Sethusamudram Project ; Or (*iii*) at a later stage, and if so, when ?	(*i*), (*ii*) *and* (*iii*).—The two Projects are closely interrelated. The success of one depends on the other. In our opinion, they should be executed as parts of one and the same Project, and completed during the Second Five Year Plan Period.

Section VI—Sethusamudram Project and Rail Traffic

54. The opening of the Sethusamudram Canal will have certain important repercussions on rail traffic and these can be considered under the following main heads :—

(i) Diversion to coastal steamers of the traffic now moving by the rail-route between the West and East Coast Ports and *vice versa.*

(ii) Indo-Ceylon traffic moved by the rail-*cum*-sea route *via* Dhanushkodi.

(iii) Pilgrim traffic to Rameswaram and Dhanushkodi and general Goods traffic to Rameswaram island.

55. *Diversion to coastal steamers of the traffic now moving by the rail-route between the West and East Coast Ports and* vice versa.—From the data collected by the Officer on Special Duty (Sri S. S. Ramasubban, Senior Deputy General Manager, Western Railway) in connection with a Preliminary investigation on Co-ordination of Railways and Coastal Shipping, a statement has been compiled showing the rail movements between the areas in the spheres of influence of the Ports on the East and West Coasts on the wider Coast line (*i.e.*, those between the Ports on the East Coast beyond Tuticorin and the Ports in the West Coast upto Tuticorin) in quantities over 2,500 tons in 1954-55. This statement is included in Appendix 'D'.

Taking such of the traffic as is regular and not spasmodic, it is estimated that the total rail movements that can be diverted to the sea-route is about 2.52 lakhs tons, out of which 1.52 lakhs tons is in the direction of East to West in which the ships are running loaded more or less to capacity and 1.08 lakhs tons in the reverse direction in which the ships are running light. The particulars of the main movements are shown in the enclosed* statement. The movement of coal has been excluded from the above assessment of diversion of traffic from the rail to the sea route. Practically the entire requirements of railway coal of the Southern Railway, a part of the requirements of the Central and Western Railways for the Bombay area and of the Gondal Region of the Western Railway is being already moved by the sea route. Very little coal is moved by the sea route on public account.

An estimate of the additional requirements of coal of the Southern Railway over and above their present receipts towards the end of the Second Plan Period shows the position to be as under :—

Railway Area	Feeding Port	Monthly consumption (in tons)		
		Present	Anticipated	Additional
Madura district . .	Tuticorin . . .	10,500	12,000	1,500
Podanur district . .	Cochin . . .	13,500	18,000	4,500
Hubli district . .	Marmugao Harbour .	16,500	20,000	3,500
				9,500

The additional requirements for the railway areas above Madras, Bezwada, Villupuram and Rayapuram Districts for which the feeding ports are Madras and Cuddalore, will not make use of the Sethusamudram Canal. In other words, an additional traffic in rail coal to the extent of 114,000 tons per year will materialise towards the end of the Second Five-Year Plan Period for passage through the Sethusamudram Canal.

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*Included in Appendix 'D'.

56. *Indo-Ceylon traffic moved by the rail-*cum*-sea route* via *Dhanushkodi.*—At present the entire passenger traffic between India and Ceylon and a part of the goods traffic is carried *via* Dhanushkodi by the rail-*cum*-ferry service. With the construction of the Sethusamudram Canal and with its increasing use by coastal steamers, it will not be feasible or desirable to run main line trains through to Dhanushkodi or Rameswaram as this will mean either detention to the ships when the Canal-Bridge is used for rail traffic or detention to main line trains when the Canal is kept open for passage of ships. In the circumstances, the railways will have to clear all Indo-Ceylon traffic *via* Tuticorin with a co-ordinated ferry service worked by private shipping companies plying between Tuticorin and Colombo. The bulk of the goods traffic between India and Ceylon is already moving by private crafts or steamers plying between Tuticorin and Colombo. Under this arrangement the railways can abandon the ferry service between Dhanushkodi and Talaimannar in which event the problems arising out of the erosion at Dhanushkodi will no longer exist. As for the continuance of the Ferry Service, the Expert Committee appointed by the Railway Board to go into the question of resisting of the Pier at Dhanushkodi have already come to the conclusion that the continuance of such a service will not be justifiable from the financial point of view.

57. *Pilgrim traffic to Rameswaram and Dhanushkodi and general goods traffic to Rameswaram island.*—This can be met by light shuttle services run from the East Bank of the Canal to Rameswaram and Dhanushkodi and for this purpose the railway will have to construct two new terminal stations—one on the west bank of the Canal for main line trains and the other on the east bank for shuttle trains. The rail-bridge over the Canal can be used only for occasional transfer of empty rolling stock from the island side to the main land. Passengers and general goods for Rameswaram and Dhanushkodi will have to be transhipped over the canal bridge. This will imply that the rail track over the Canal-bridge need not be of the high main land standard as it will be required to be used only occasionally for sending the shuttle engines to Madura for attention once a week and for the Coaching Stock to be worked to the Shops, at Golden Rock. When rail communications on the island portion get thus isolated, railways will have to put up quarters for their running staff at suitable points on the island.

Goods traffic at present interchanged between the main land and stations on the Rameswaram island, of which the volume during 1953-54 was approximately 1,97,971 maunds (outwards) and 2,94,929 maunds (inwards) will then have to be booked only upto the terminal station on the West bank of the Canal and taken either by road to Rameswaram or Dhanushkodi or offered for re-consignment by rail at the terminal station on the East bank of the Canal. The outwards goods traffic from the island is mainly dry fish, and to a small extent firewood and the inwards traffic comprises of grain, pulses and seeds, oils, general stores, fruits and vegetables.

Section VII—Concluding Remarks

58. *Sethusamudram Legislation*—If the Project is executed, it will be necessary to make provision by special legislation for the permanent maintenance of the navigational works and facilities brought into being thereby. The canal, the various approach channels, the lock and the bridge will have to be maintaind and conserved. The statutory authority will have to be established; its jurisdiction will have to be defined; (this may possibly entail reference to the Sethusamudram Medial Line) and it should be given legal authority to levy dues on ships using the route and to regulate their movements on the route and safeguard their navigational safety and conveniences.

59. *Sethusamudram Authority*—Since the creation of a Sethusamudram Authority would be essential at a later stage, it would be an advantage, in advance of legislation, to set it up under executive orders immediately upon sanction of the Project. This would enable the execution of the Project to be supervised closely and carried out efficiently and expeditiously. The necessary financial and administrative powers can be delegated so as to secure this result.

It will be necessary to give careful consideration to the composition of this Authority. We think it is essential that it should be composed of representatives of the Government of India, the Government of Madras, the Indian Shipping Companies, the Southern Railway and the Tuticorin Port Trust.

60. *Sethusamudram Ship Yard*—Before concluding this Report, we desire to invite the attention of the Government of India to the special features of the site which we have selected and recommended for the location of the Sethusamudram Canal. It is situated in the vicinity of a natural harbour with a shore-frontage of about 7 miles. There is a railway and a national highway lying immediately behind this frontage. Land is available in plenty and can be acquired at low cost. Electric power is available. The sea in this area (as in the south generally) has a very low range of tides.

We understand that the co-existence in one place of all these advantages renders the area in the vicinity of Sethusamudram Canal exceptionally well suited for the location of a ship building and allied industries. At present, India has got only one ship yard at Vishakapatnam. As our works was nearing conclusion, the newspapers carried the report that the Government of India had taken the decision that a second ship yard should be established somewhere in the country and that they were on the look out for a suitable site.

We have, therefore, considered it appropriate that we should bring these facts to the notice of the Government of India. We suggest that the possibility of establishing the second ship yard required by the country in the vicinity of the Sethusamudram Canal may be investigated.

61. *Acknowledgments*—We have referred in Section I of this Report to the sources from which we secured information and the various authorities, persons and bodies who were good enough to assist us in our enquiry. We desire specially to place on record our obligation to the authorities in charge of the Madras and Calcutta Ports. It was not easy to collect the detailed information which we needed, accurately as well as expeditiously. We are grateful for their cooperation.

Sri J.M. Frederick, the Chief Engineer to the Government of Madras took part in our local enquiries and investigation. We thank him for giving us the benefit of his valuable advice and rich experience. Other officers of the Public Works Department and Port Department of the Government of Madras also assisted us at many stages of our enquiry.

We owe a special debt to Captain L.G. Hardas, Port Officer, Tuticorin and the Officers and crew of the Tug 'Mannar'. They worked long hours ungrudgingly and made it possible for two members of our Committee to undertake the reconnaissance of the entire Sethusamudram Navigation Route on two different occasions and to carry out various local enquiries.

Sri A. Rama Rao, Marine Superintendent, Mandapam, carried the burden of arranging at short notice for the stay of a sub-Committee of this Committee at Mandapam and for carrying out local investigations in that area.

Sri A. J. Chandy, Assistant Secretary to the Government of Madras, Public Works Department, whose services were placed at the disposal of the Committee, spared no pains in arranging for the tours of the Committee and its business throughout the last few months. His personal services have been of considerable help to the Committee. The Committee is also grateful to Sri K. Anandam, Superintendent, Public Works Secretariat and the staff under his control for handling the correspondence and the mass of statistics which came through in a relatively short time and prepared it for the use of the Committee.

Finally, we desire to place on record our grateful appreciation of all the facilities placed at our disposal by the GOVERNMENT OF MADRAS.

(Sd) A. Ramaswami Mudaliar,
Chairman.
(Sd) S. K. Mukerji,
Member.
(Sd) B. N. Chatterjee,
Member.
(Sd) J. R. Davies,
Member.
(Sd) R. A. Gopalaswami,
Member Secretary.

REPORT OF THE SETHUSAMUDRAM PROJECT COMMITTEE

Annexure I—Part B

THE SETHUSAMUDRAM ROUTE

Navigational Aspect

I. General.—(1) The fundamental requirement of the Sethusamudram Route is to connect the Gulf of Mannar with the Bay of Bengal in order to shorten and improve sea communications between the West and East coasts of India whereby ships as large and as deep a draught as possible can navigate with safety and avoid making the long detour round the south of Ceylon which is at times subject to adverse weather conditions.

(2) Such a route entails a passage through the Gulf of Mannar northwards to the head of the gulf and transit by means of an artificial waterway cut through the Thonithurai Peninsula, Rameswaram Island or Adams Bridge into Palk Bay, thence through Palk Strait into the Bay of Bengal.

(3) There already exists an artificial waterway known as the Pamban Pass at the western extremity of Rameswaram Island, but this is only suitable for vessels up to 11 feet draught. On account of the nature of the bottom in the Pass (hard rock) and the shallow water in the difficult approach from the Gulf of Mannar it is not suitable for deepening for the use of larger and deeper draught vessels.

(4) Providing there is an artificial waterway with sufficient depth of water the governing factor for the maximum draught of vessels which may safely use the Sethusamudram Route is the depth of water existing over the shallowest part of the main route (excluding approach channels and comparatively short distances which can be dredged to the required depth). This part of the route is in Palk Bay.

(5) Admiralty chart No. 68*a* "Palk Strait and Gulf of Mannar", indicates that over a large area of Palk Bay depths of between 5½ fathoms (33 feet) and 6 fathoms (36 feet) exist. These depths were confirmed over the route by soundings taken in December 1955 and again in February this year.

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In view of this it is considered that it would be reasonable and justifiable to allow for the route having a minimum depth of 32 feet throughout and to prescribe a maximum draught of 26 feet for vessels using the route. It may be possible at a later date to increase this figure after experience has been gained in using the route and when additional surveys have been carried out. The figure 26 allows for 8 foot swell, and a clearance of 2 feet under the keel, *i.e.*, 8/2 plus 2=6 feet allowance.

(6) With regard to the depths of water in the Palk Strait through which ships must pass to enter the Bay of Bengal between the eastern coast of India and the northern coast of Ceylon, there are three principal channels, *i.e.*, the West and Pedro channels with a least depth of 5½ fathoms (33 feet), the middle channel with a least depth of 3¾ fathoms (22½ feet) and the northern channel with a least depth of 3¼ fathoms (19½ feet).

(7) By using the West and Pedro channels vessels pass within 3 miles of the northern and eastern coasts of Ceylon and have to make a detour of 40 and 60 miles respectively if bound to Calcutta or Madras and would not, therefore, obtain the full benefit of the shorter route from the Western Coast of India to the Bay of Bengal. By using the middle or northern channel the full benefit of the shorter route would be obtained. The navigational aids along the West and Pedro channels are at present considered inadequate and would require improvement and augmentation before a regular flow of shipping of vessels of any appreciable size could navigate them with confidence. The middle channel (which das deeper water than the northern channel) has therefore been included in the hroposed route and provision made for it to be dredged to a depth of 32 feet.

II. Weather and Sea conditions of Gulf of Mannar and Palk Bay.—(1) Ships using the Sethusamudram Route must pass through the Gulf of Mannar and Palk Bay and will be subject to weather and sea conditions prevailing in these areas.

(2) The prevailing winds are north-easterly during the Northeast monsoon, *i.e.*, from the end of November to early April when the winds become variable. From May to October the prevailing winds are south-westerly, *i.e.*, the Southwest monsoon, and then variable until the commencement of the North-east monsoon again in November.

(3) During the North-east monsoon, the force of the wind seldom exceeds that of a fresh breeze and sea and swell conditions in the Gulf of Mannar and Palk Bay are rarely if ever such as to impede the movement of shipping. The natural formation of the Gulf of Mannar and Palk Bay, both bordered by land on three sides tend to make the navigable waters contained therein more favourable for shipping than the open sea. Even off the exposed shores of the Thornithorai Peninsular and Pamban, Palk Bay the force of wind and the conditions of the sea is seldom so severe that an open boat could not be handled safely during the height of the North-east monsoon.

(4) During the South-west monsoon fresh to strong winds prevail from July to the end of September and sea and swell conditions in the Gulf of Mannar are less favourable than at any other time of the year, at the head of the Gulf the wind is more moderate, and on the western side of the gulf the wind, sea and swell is less severe than anywhere else in the gulf due to the natural protection provided by the land forming the southern coast of India. The wind, sea and swell conditions in the gulf of Mannar during the South-west monsoon are in general not such as to appreciably impede navigation, and as already stated, some shelter from these elements can be obtained on the western side of the gulf, by means of which vessels will be able to make better headway than in the open sea fully exposed to the South-west monsoon.

In Palk Bay during the South-west monsoon, wind, sea and swell conditions are generally favourable for navigation and conducive to a quicker passage than *via* the open sea south of Ceylon where vessels would be fully exposed to the South-west monsoon.

III. Tidal Streams and Currents on Proposed Route.—The tidal streams normally follow the general directions of the coast and except during spring tides seldom attain a rate of more than 1 knot.

The maximum range of the tide is about 3·5 feet.

Currents are weak over the whole route and generally flow with the direction of the prevailing wind.

IV. Route Proposed.—(1) The proposed Sethusamudram Route has been indicated in detail on Admiralty chart No. 68*a* "Palk Strait and Gulf of Mannar" submitted with the Committee's Report. The entire route, excepting of course that portion of the route through which the canal is to be cut, has been navigated by two members of the Committee, in February 1956, and that part of the proposed route in Palk Bay to middle channel and Point Calimere was also navigated during December 1955 by the same two members of the Committee. Visual sea and swell observations were made throughout and numerous soundings taken to ascertain the depths of water. These soundings confirmed the depths indicated on Admiralty chart No. 68*a*.

(2) The route has been indicated with the port of Tuticorin as a starting point from the west, although the starting point could be taken from any position in the Gulf of Mannar. The Bay of Bengal end of the route is on the six fathom contour line at the eastern entrance to the middle channel, Palk Strait, in latitude 10° 06′ 15″ N., Longitude 80° 01′ 48″ E.

The route is to have a minimum depth of water of 32 feet to enable ships of up to 26 feet draught to use it.

must be comparatively narrow, and with heavy breakers on either side, it would not, from the navigational point of view be advisable to connect the Gulf of Mannar with Palk Bay by a channel in the vicinity of Adams Bridge.

(5) It will be observed that the route now proposed contains three features which are important so far as the movement of shipping is concerned, *i.e.*, it is the shortest possible route for ships between 13½ feet and 26 feet draught, secondly the fullest natural protection obtainable from wind, sea and swell in the Gulf of Mannar during the South-West monsoon is obtained by siting the southern approaches and entrance to the canal as far to the westward as possible, and thirdly, a natural sheltered anchorage with deep water is available in the near approach to the southern entrance to the canal, formed by a barrier of islands and reefs which lie 5 miles seawards from the mainland.

V. Navigational Aids and Pilotage.—(1) A separate statement has been prepared and submitted to the Committee giving a detailed list of additional navigational aids required and improvements that will be necessary to existing aids, in order that the route is adequately marked for safe navigation by day and night in all weathers.

(2) Pilotage between the southern and northern approaches to the canal including the canal transit, should be compulsory, that is to say a vessel from the Gulf of Mannar bound northwards will take a Pilot on board close south of the channel through the reef in approximate position Lat 9° 09′ N, Long 79° 00′ E, the Pilot will remain on board until the vessel has passed through the canal and arrives at the Fairway Buoy at the northern approach to the canal in approximate position Lat 9° 20′ N, Long 79° 06′ E. This pilotage procedure will also apply, but in the opposite direction for vessels bound southwards from Palk Bay to the Gulf of Mannar.

(3) Provision should also be made for Pilots to be available for those vessels which may require pilotage through the buoyed middle channel, Palk Strait. This provision has been included in the statement mentioned in sub paragraph 5 (1) above.

VI. Marine Survey of the Proposed Route.—Although there is no reason to doubt the accuracy of the information contained on the Admiralty charts and in the West Coast of India Pilot (Ninth Edition, 1950) and the Bay of Bengal Pilot (Eighth Edition, 1953) with regard to the depths of water and navigational features existing on the proposed route (some of which has been confirmed by inspection of the route as recently as December 1955 and in February this year by two members of the Committee) it is considered desirable in the general interest and in view of the possible development of ports and places along the route that the sea area through which the route passes be resurveyed as soon as the work can be undertaken by the Hydrographic Department of the Indian Navy. It is recommended that a favourable priority be granted in this regard. This need not delay the route being prepared and brought into use forthwith, as from the navigational point of view the proposed route when completed as recommended by the Sethusamudram Project Committee will be suitable and safe for shipping.

(Sd.) J. R. DAVIES,
25.3.1956

(12) *Palk Bay "No. 1 Lightvessel", in approximate position.—Lat. 10° 06′ 52″ N., Long. 80° 01′ 07″ E. (new).*—A lightvessel to be moored in this position to mark the Bay of Bengal eastern end of the route through the middle channel. The lightvessel to exhibit a flashing (white) light, four flashes every thirty seconds and to be visible eleven miles. Vessel to be fitted with radio telegraphy and radio-telephony; also to have living accommodation for six pilots and be fitted with two sea-going pilot motor boats 26 to 28 feet in length with means of launching and recovering them.

(13) *Middle Channel Palk Strait buoyed Channel approximate length 11.5 miles (new).*—Twenty lighted buoys, ten starboard hand and ten port hand in accordance with the "lateral" system of uniform buoyage. Buoys to be laid on each side of the 750 foot channel one mile apart.

(14) *Point Calimer Lighthouse, Lat. 10° 18′ N., Long. 79° 52′ E. (existing).*—Range of light to be increased from 12 to 20 miles. Character unchanged, *i.e.*, Group flashing three, every ten seconds.

2. *Responsibility for providing and maintaining navigational aids described above.*

(*i*). Items (1), (2), (7), (10), (11), (12), (13) and (14) are considered "General Aids" to navigation, that is to say they will be of use to shipping in general whether or not they use the Sethusamudram Route; and as such will be the responsibility of the Lighthouse Department, Ministry of Transport, Government of India.

(*ii*). Items (3), (4), (5), (6), (8) and (9) are considered "Local Aids" to navigation, that is to say they will be mainly for shipping using the Sethusamudram Route, and as such will be the responsibility of the Sethusamudram Authority.

(*iii*). Provision should be made on "PALK BAY NO. 1" Lightvessel for the accommodation of six pilots to serve those ships which may wish to have a Pilot for navigating the buoyed middle channel. The cost of this accommodation and two small pilot boats for boarding will have to be borne by the Sethusamudram Authority.

3. *Summary of Requirements.*

*(*i*) (1) and (14) two existing Lighthouses to be improved.

*(*ii*) (2) and (7) Two new Lighthouses to be erected.

(*iii*) (3), (4), (6), (8) and (9). Twenty buoys.

(*iv*) (5). Two beacons.

*(*v*) (10), (11) and (12). Three Lightvessels.

*(*vi*) (13). Twenty buoys.

*Indicates responsibility of Lighthouse Department.

(Sd.) J. R. DAVIES.
24-3-1956.

SETHUSAMUDRAM PROJECT COMMITTEE

Adimiralty Chart No. 68*a* on which is shown the proposed shipping route from Tuticorin and Gulf of Mannar to the Bay of Bengal *via* cannal (to be cut through the peninsular approximately 5 miles west of the conspicuous water tower Mandapam) Palk Bay and Palk Strait (Middle Channel).

Explanation

(1) The black continuous line marked A, B, C, D and E represents the delimitation of Palk Straits and the Gulf of Mannar between India and Ceylon.

(2) The green continuous line represents the proposed route Tuticorin and the Gulf of Mannar to and from the Bay of Bengal.

This route to have a minimum depth of 32 feet to enable ships of up to 26 feet draught to use the route.

The courses and distances on the proposed route are as follows :—

(i)	From Tuticorin to position Lat. 9° 09′ 00″ N. Long. 79° 00′ 00″ E.	065°(T)	51·0 miles.
(ii)	Thence to position Lat. 9° 12′ 00″ N. Long. 79° 00′ 30″ E.	009°(T)	3·0 „
(iii)	Thence to southern entrance to canal in Lat. 9° 15′ 48″ N. Long. 79° 02′ 40″ E.	027°(T)	4·5 „
(iv)	Thence through canal	044°(T)	2·5 „
(v)	Thence to position Lat. 9° 58′ 45″ N. Long. 79° 34′ 36″ E.	036°·5(T)	50·5 „
(vi)	Thence to 6 fathoms contour line in Lat. 10° 06′ 15″ N. Long. 80° 01′48″ E.	074°(T)	27·5 „
	Total distance on proposed route		139·0 miles

(3) The shaded green portions of the route mentioned at (2) above indicate the approximate areas to be dredged.

(4) The small red figures indicate additional navigational aids required to mark the channels and the route, such as lightvessels and buoys, etc. (See separate list for navigational aids for the route).

(5) The red arcs and circles indicate the range of visibility of Lighthouses, Lightvessels and Fairway Buoys, etc. on the route.

(6) The red dotted line indicates an alternative route *via* the Northern channel close to Point Calimere. This channel has a minimum depth of water of 19 feet 6 inches, it would permit vessels of up to 13 feet 6 inches to use the route.

(7) The dotted green lines indicate two alternative routes from and to the Palk Bay end of the canal. One, is *via* the East and West Channels close to the coast of Ceylon but outside the 3 mile limit. The minimum depth of water on this route through the East channel is 24 feet, it would permit ships of up to 18 feet draught to use this route.

The second route is *via* the West Channel and Pedro Channel close to the coast of Ceylon and within the 3 mile limit. The minimum depth of water on this route through the West Channel is 33 feet, it would permit ships of up to 26 feet draught to use this route.

(Sd.) J. R. DAVIES.
19-3-1956.

REPORT OF THE SETHUSAMUDRAM PROJECT COMMITTEE

Annexure II

SETHUSAMUDRAM PROJECT

Detailed Statement and Drawings—I

Cost (Rs. in lakhs)

I. *Sethusamudram Canal*— Drawing No. 1, 2 and 3

Total length . . . . 5,400 yds.

(a) Land above 2·00 Average depth 2·33 yds. Bottom level for channel 32·00. Side slopes ½. Total excavation 17·55 or say 18·00 lakhs cu. yds.
Cost at Re.1/- per cu. yd. . . . . 18·00

(b) Submerged cut between—2 and 32·00. Bottom width of channel 50 yds. Side slopes 1/4. Total quantity of excavation 48·6 or say 49·00 lakhs cu. yds.
Cost at Re.1/- per cu. yd. . . . . 49·00

II. *Sethusamudram Canal—South Approach Channel (Outer Section)*—Drawing No. 4

Reef Cut

Total length . . . . 870 yds.
Width of channel at 32·00 is 250 yds. Average depth of coral rock cut is 4 yds. Total quantity of cut is 8·7 lakhs cu. yds.

Cost at Rs. 3/- per cu. yd. (26·1 lakhs) . . . . 26·00

III. *Sethusamudram Canal—South Approach Channel (Inner Section)*—Drawing No. 4

Total length . . . . 9,270 yds.

Bottom width of channel at 32·00 is 150 yds. Width of chhanel at Main land is 50 yds. There is a uniform slope. Average depth of cut is 4 yds. Side slopes of channel 1/4. Total quantity of excavation 42·00 lakhs cu. yds.

Cost at Re. 1-4-0 per cu. yd. . . . . 53·00

IV. *Sethusamudram Canal—North Approach Channel and North Protection work*—Drawing No. 5.

Total length . . . . 7,100 yds.

Bottom width of channel at 32·00 is 150 yds. tapering to a width of 50 yds. at main land. The slope is uniform side slope 1/4. Average depth of cut is 4 yds. Total excavation 33 lakhs cu. yds.

Cost at Re. 1-4-0 per cu. yd. (41·25+7·75) . . . . 49·00

V. *Sethusamudram Canal Lock and Lock Gates*—Drawing No. 6.
Lock chamber walls and 3 Lock gates (Caisson) (80+40) . . 120·00

VI. *Sethusamudram Canal Bridge*—Drawing No. 7.
Swing Bridge (Road 24′ width) on National Highways. . . 22·00

VII. *Bay of Bengal Approach Channel*—Drawing No. 8.

Total length of cut . . . 24,080 yds.

Bottom widths of channel at —32·00 is 250 yds. and average depth of cut is 1½ yd. side slopes 1/4. Total excavation 77·0 lakhs cu. yds.
Cost at Re. 1/- per cu. yd. . . . . 77·00

	Cost (Rs. in lakhs)
VIII. *Tuticorin Harbour Approach Channel*—Drawing No. 9.	
Total length of cut . . 5,400 yds.	
Bottom width of channel at —36·00 is 100 yds. Total quantity of excavation is 34 lakhs cu. yds.	
Cost at Rs. 3/- per cu. yd.	102·00
IX. *Tuticorin Harbour—Anchorage and Pier—between A and B*—Drawing No. 10.	
Including Metre Gauge Railway line from A to B in Seltive Reef and Railway sidings.	60·00
X. *Sethusamudram Project Headquarters*— Land and Buildings—*Vide* Statement No. II.	57·00
XI. Sethusamudram Project Vessels Machinery and Navigation Aids—	
Vide Statement No. III	277·00
XII. Sethusamudram Project Establishment at about 6 per cent on works	40·00
Add unforeseen contingencies at 5%	48·00
	Rs. 998·00

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STATEMENT—No. II

SETHUSAMUDRAM PROJECT HEADQUARTERS

Lands, Buildings and other connected Shore Works

	(Rs. in lakhs.)
1. Land Surveys, Marine survey of approach channels, Alignment, other preliminaries and cost of land, demarcation, borings, etc.	10·00
2. Workshop buildings, Machinery, etc.	15·00
3. Buildings, Offices, Establishment lines, Hospital and other connected buildings.	15·00
4. Water Supply and Drainage for Colony and works.	10·00
5. Electric supply and Power lines for Colony and works	5·00
6. Other unforeseen items	2·00
TOTAL	57·00

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STATEMENT—No. III

SETHUSAMUDRAM PROJECT

Vessels, Machinery and other Navigational aids

	(Rs. in lakhs.)
1. Suction, Cutter and Hopper dredgers (2)	100·00
2. Dipper dredger and Rock-breaker	50·00
3. Barges for conveyance of materials to land, etc.	10·00
4. Land equipment and earth moving machinery	50·00
5. 24 Nos. Buoys at Rs. 2,000/- each	0·48
6. Vessel for Buoy attendance	15·00
7. Two Tugs at Rs. 15·00 lakhs each	30·00
8. 3 Pilot launches at Rs. 75,000/- each	2·25
9. Navigational aids L.S. (including Beacons)	2·47
10. Hydraulic machinery, Pumps, Accumulators, etc.	15·00
11. Radio Communications, Signal equipment, etc.	0·50
12. Mooring boats 6 Nos. at Rs. 5,000/- each	0·30
13. Temporary jetties	1·00
TOTAL	277·00

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STATEMENT No. IV

PART I

Suction Dredger with hopper (Proposed specification)

Required for service in the Bay of Bengal, Palk Bay and Gulf of Mannar. It will be required in the first instance to dredge a shoal in the Bay of Bengal from depth 21 to 32 feet below sea level. Material is to be dredged and drawn by suction from the bottom and discharged into its own hopper and deposited into deep sea about 5 miles away. Material to be dredged is coarse sand mixed with stiff mud. A Rotary cutter blade is therefore to be provided to cut through tenacious clay. The vessel must be self-propelled and sea-worthy and must cut her underway.

At two other sites it may be required to dredge sea shore to connect it to a newly cut canal and may be required to discharge spoil by pipe line to reclaim both lands.

Dredging Rate—2000 to 2500 tons of sand and mud per hour

Hopper capacity—4000 to 5000 cubic yards.

Maximum dredging depth—32 feet.

Light working draft not to exceed—about 12 feet or so.

Light draft not to exceed 8 feet 6 inches.

Loaded draft not to exceed—about 16 feet.

The weight of sand and clay is to be taken at 20 cubic feet to the ton. Slight variations might occur.

Power—Steam, Steam Electric or Diesel Electric.

Number of Vessels required—Two.

Alternatively the following will be required—

(1) Two self propelled sea going suction Dredgers to carry out the same duty but they are to be without hoppers.

(2) Four separate self propelled sea going Hopper Barges with a capacity of 4000 to 5000 cubic yards each.

Quantity of material to be dredged at the shoal middle channel—
=75,00,000 cubic yards = 112,50,000 tons.

Time required to dredge this shoal by two suction Dredgers of the above specifications working 10 hours a day—

$$\frac{112{,}50{,}000}{2\times2000\times10}\qquad\frac{\text{Tons}\times\text{Day}}{\text{Tons}}$$

=281 working days.

=about 1 year.

Quantity of materials to be dredged at both the approaches of the canal—

=75,00,000 cubic yards = 112,50,000 tons.

Time required to complete this work is 281 working days =say 1 year.

PART II

Extract from letter dated 10th October 1955 from Sri B. N. Chatterjee, Chartered Civil Engineer, 35, Dr. Sarat Banerjee Road, Calcutta-29 to the Secretary to Government, Public Works Department, Fort St. George, Madras-9.

Development of Tuticorin Port

XX XX XX

At current rates a new Rock Breaker will cost about Rs. 15 to Rs. 20 lakhs and a Dipper Dredger about Rs. 25 to Rs. 30 lakhs.

I recently secured some information regarding two old vessels-Dipper Dredger (Walrus) and Rock Breaker (Nantilus) belonging to the Bombay Port Trust, which might prove equal to the task at Tuticorin. As these were purchased at very much lower rates many years ago and have since depreciated considerably in value, it might be possible to purchase these from the Bombay Port Trust at a tenth or less of the price of new vessels and thus offset a considerable saving in the costs of the Tuticorin Project.

A few weeks ago I inspected these vessels the Dipper Dredger "Walrus" and the Rock Breaker "Nantilus". The former was procured in 1914 for the purpose of removing Coffer dam erected in the harbour during the construction of Alexandra Basin. This particular piece of work for which the vessel was designed has long since been completed. I understand the vessel is lying idle and has not been used for several years.

The Rock Breaker "Nantilus" was purchased in 1925 and was used for a few months only. During the last war this vessel was towed to Trincomallee and after about two years use was returned to Bombay and has since been lying idle.

The original purchase prices of these vessels were as follows :—

Walrus	Rs. 3,75,000
Nantilus	Rs. 3,20,000

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I should add, moreover, that these vessels were procured in pieces and later assembled at the port and the above prices do not include assembling charges. Both vessels are non-propelling.

At present apparently Bombay Port Trust has no use for these vessels. Some development work, the contract for which has already been let out, will soon be started.

The contractors may decide to use these vessels and if required by them they will be in use for two years or so, after which the vessels will remain idle again. Whether the vessels will be required by the contractors, who, I am told, already own a rock breaker, will be decided by April next year.

The particulars of the vessels are appended below—

***WALRUS*:**

Length between perpendiculars	110′—0″
Breadth moulded	40—0″
Depth	11′—0″
Draft light forward	6′—0″
Draft light aft	5′—0″
Gross Tonnage	492—1 tons.
Buckets	4 cu. yd. & 6 cu. yds.

Dipper Arms

Short Arm Digging depth	3'—6"
Long Arm Digging depth	44'—0"

Designed capacity

400 tons /hour free material at	25'—0" depth.
Draft of water to clear spud feet	10'—0"
Maximum reach when dumping	35'—0"
Clear height of dump above water	16'—0"

It digs its own floatation.

NANTILUS:

Length between perpendiculars	110'—0"
Breadth moulded	33'—0"
Depth	9'—0"
Average Draft	5'—0"

Rock cutting Chisel	10 tons.
Length	21'—4½"
Diameter	20½"
Average penetration	4'—0" per hole.
The holes being spaced	3'—0" centres.

Main hoisting winch has been designed to operate in 60 feet of water.

Gross tonnage	432 tons
Dredging depth	48 feet.

The dimensions and capabilities make them particularly suitable for the work at Tuticorin. I would mention that the rocks dealt with at Bombay were Basalt whereas in the case of Tuticorin, only conglomerates, which are considerably softer, require to be broken. Ten ton rammers operated successfully on Basalt in Bombay and accordingly no heavier rammer would be required for the work at Tuticorin.

Both these vessels still have many further years of useful life and could complete both the protected works at Bombay and Tuticorin.

The present book values of these vessels should not be very substantial. But to put these in working condition certain repairs would have to be carried out. The estimated costs are—

Walrus	Rs. 3,00,000
Nantilus	Rs. 1,75,000
Fixing false bows to both the vessels for towing	Rs. 30,000

* * * * *

(TRUE EXTRACT)

SETHUSAMUDRAM PROJECT

DEVELOPMENT OF TUTICORIN

Navigational aids required to mark the 36 foot channel

(1) One Fairway Buoy fitted with light and bell. Light flashing white every 3 seconds and to be visible for 5 miles in clear weather. In approximate position Hare Island Lighthouse bearing 255° (T) distant 3·1 miles about half a mile eastwards of seaward entrance to channel.

(2) Leading marks and lights to mark the centre of the channel:

(a) The rear mark and light to be in approximate position, Hare Island Lighthouse bearing 130° (T) distant 2·75 miles.

(b) The front mark and light to be erected on Seltive Reef.

(c) Marks to be conspicuous, and lights to be fixed green, rear light visible 10 miles and front light 5 miles, in clear weather.

(3) Six channel marking buoys 5 cables apart along the sides of the seaward end of the channel, three starboard hand and three port hand. Buoys to be in accordance with the "lateral" system of uniform buoyage and to be fitted with lights.

(4) Six channel marking beacons 5 cables apart along the sides of the harbour end of the channel, to be marked and lit in accordance with the "lateral" system of uniform buoyage.

(5) Two beacons to mark the southern limits of the turning basin.

2. All these navigational aids will be the responsibility of the Sethusamudram Authority.

3. *Summary of requirements.*

(i) Fairway Buoy.
(ii) Leading marks and lights (2).
(iii) Six channel marking buoys.
(iv) Six channel marking beacons.
(v) Two beacons for turning basin.

Sd. J. R. DAVIES
24-3-1956

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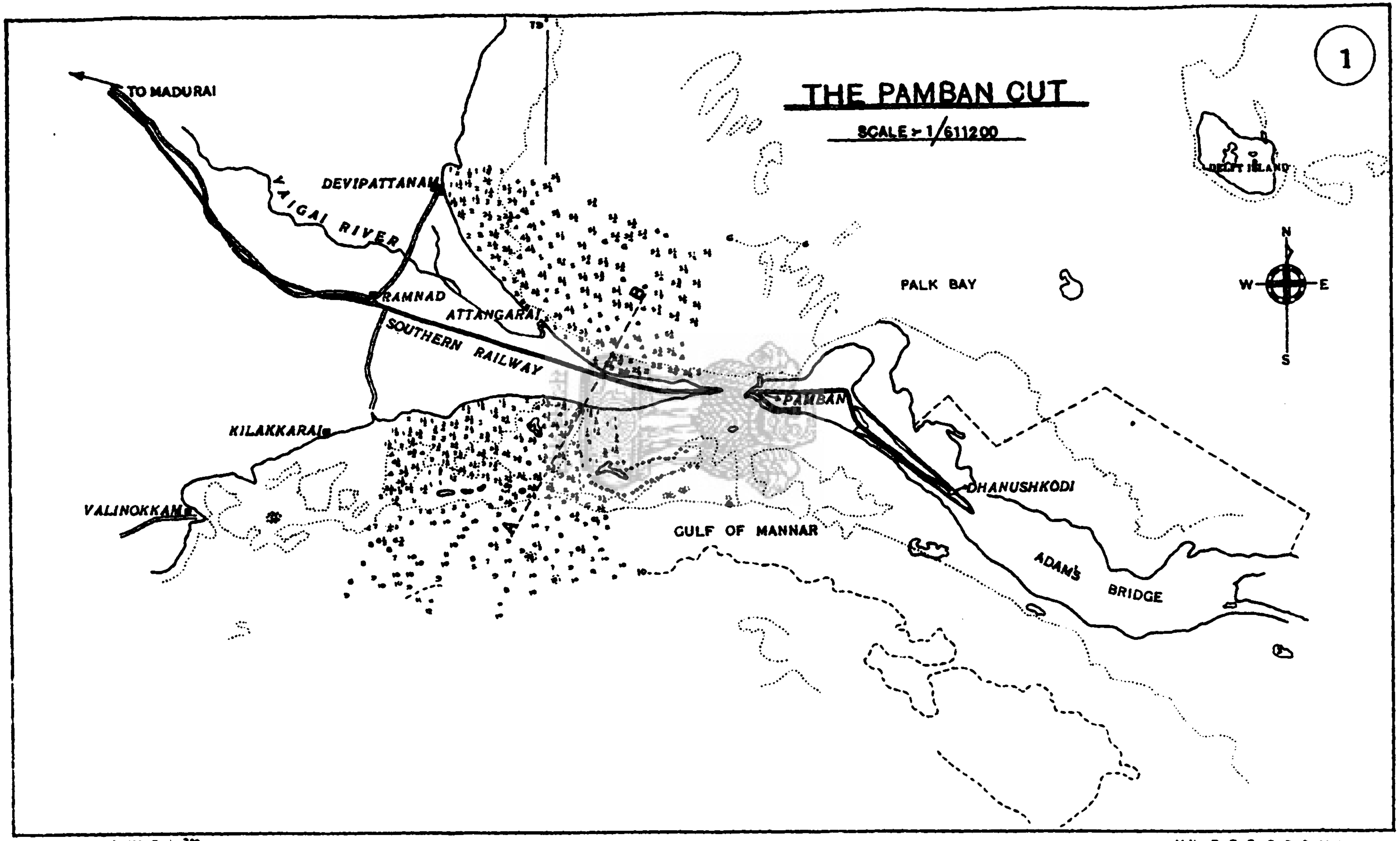

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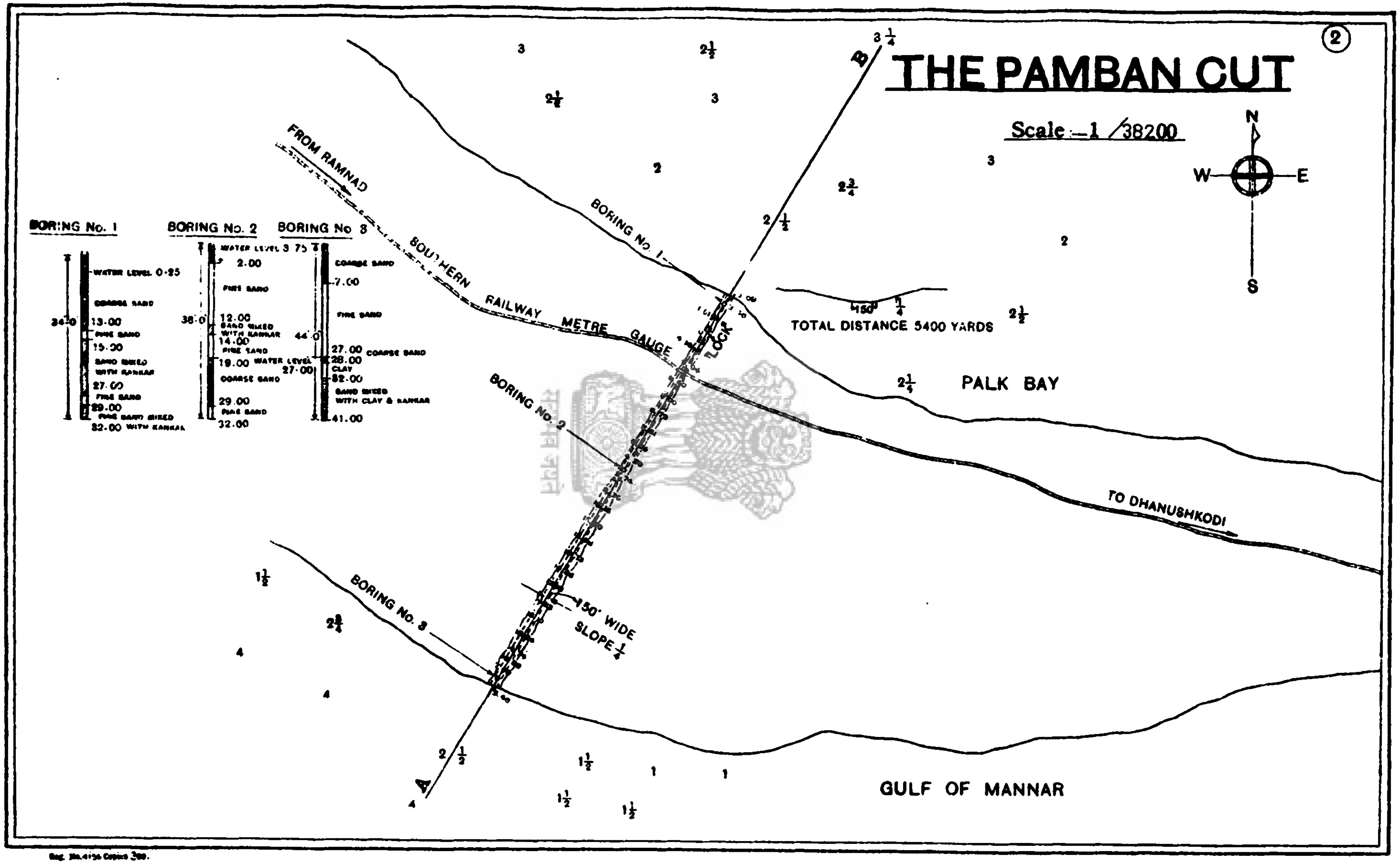
THE PAMBAN CUT



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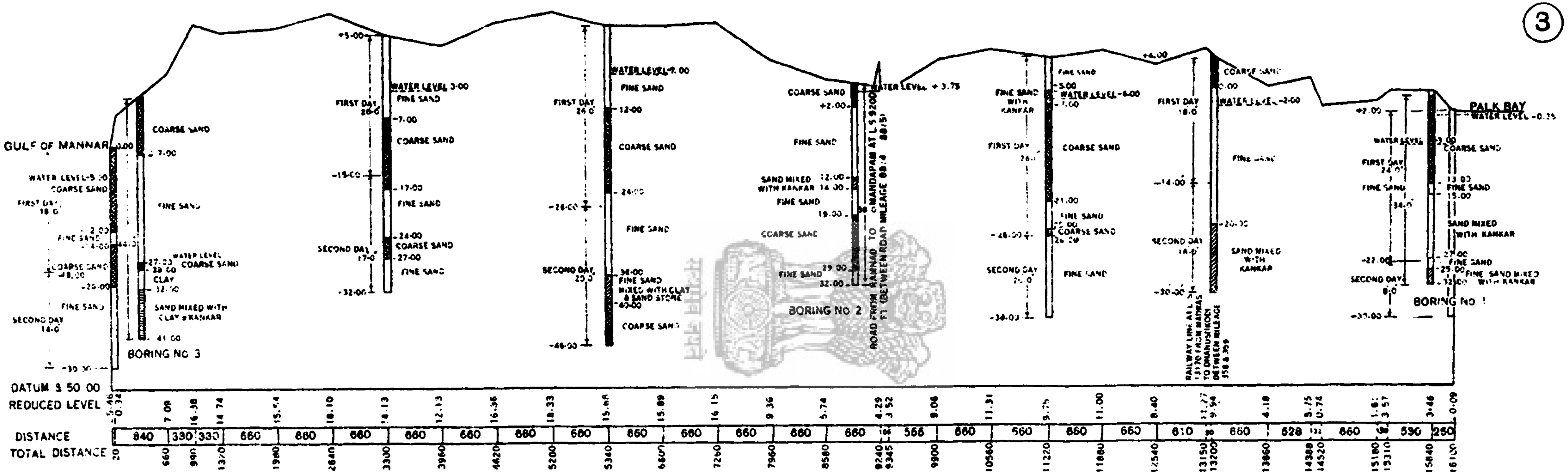
③



L.S. ALONG NORTH-EAST SOUTH-WEST LINE
ONE MILE WEST OF PILLAIMADAM VILLAGE

NOTE · THE LEVELS ARE WITH REFERENCE TO G. T. S. BENCH MARK 29/58 0 ON THE NORTHERN SIDE OF ROAD RAMNAD TO PAMBAN 76 FEET NORTH WEST OF FURLONG STONE 86/7 FROM MADURA VALUE OF WHICH IS 9.089
CERTIFIED THAT THE LEVELS WERE TAKEN AND RECORDED ON PAGES 1806 OF L F BOOK No. 449 AND PLOTTED BY ME

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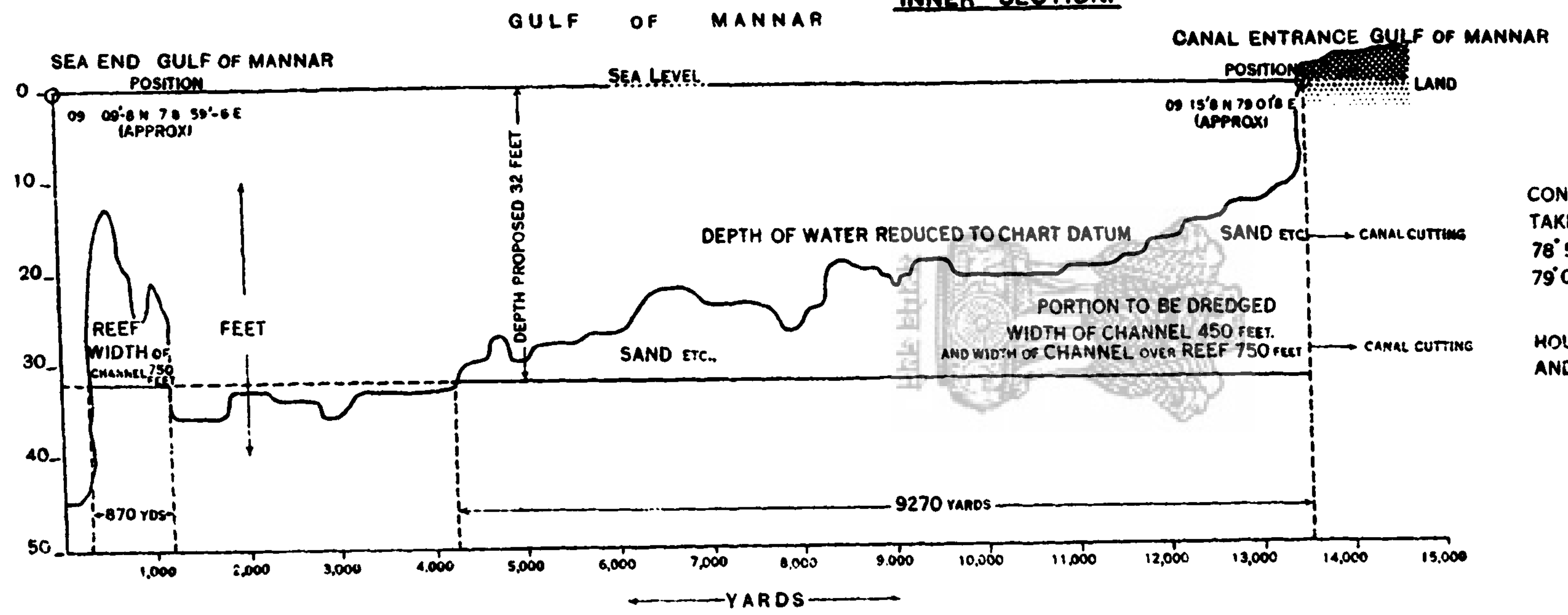
SOUTH APPROACH CHANNEL - REEF OUT AND INNER SECTION.

④



GRAPH SHOWING DEPTH OF WATER AND THE CONTOUR OF SEA BOTTOM AS INDICATED BY SOUNDINGS TAKEN ON A LINE 020°T FROM POSITION 09° 09'.8 N 78° 59'.6 E (APPROX) TO THE SHORE POSITION 09° 15'.8 N 79° 01'.8 E (APPROX) OVER A DISTANCE OF 6.66 MILES

SOUNDINGS TAKEN FROM 1435 HOURS TO 1618 HOURS, I. E., DURING THE PERIOD $00^H\ 09^M$ AFTER H. W. AND $01^H\ 52^M$ AFTER H. W. ON THE 25TH FEBRUARY, 1956.

L. W. $08^H\ 11^M$ 0.4 FT. H. W. $14^H\ 26^M$ 2.1 FT.

AFTER DAVIES DT. 10-3-1956.

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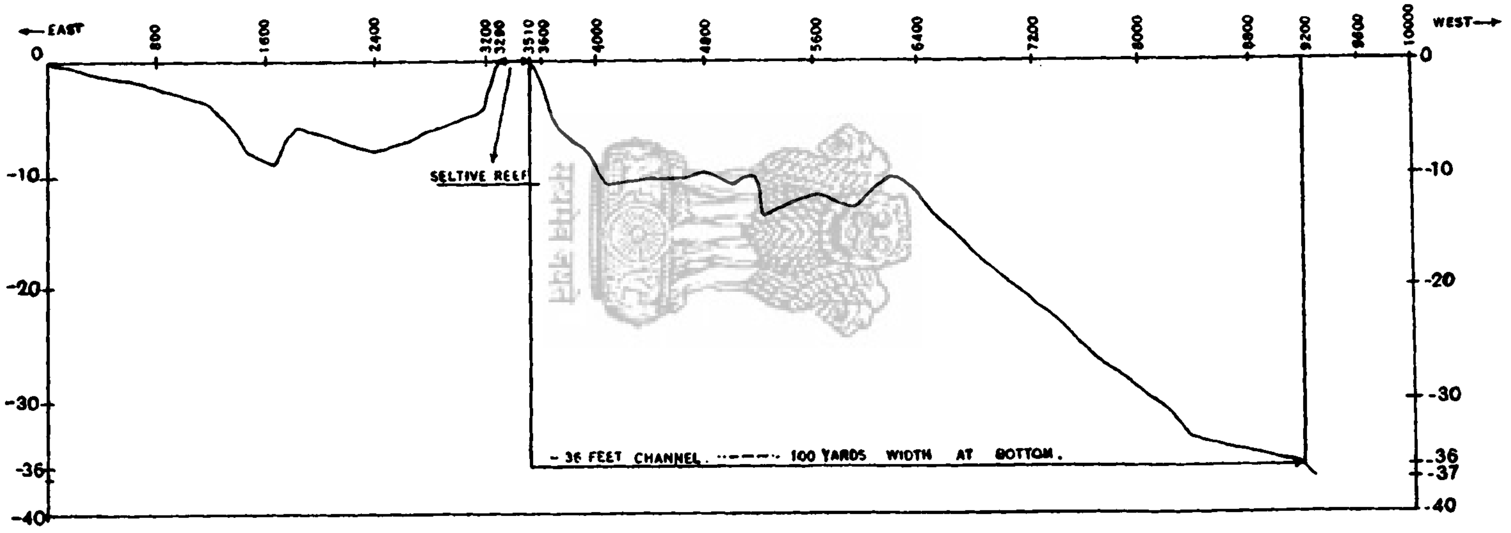
TUTICORIN HARBOUR APPROACH CHANNEL

⑨



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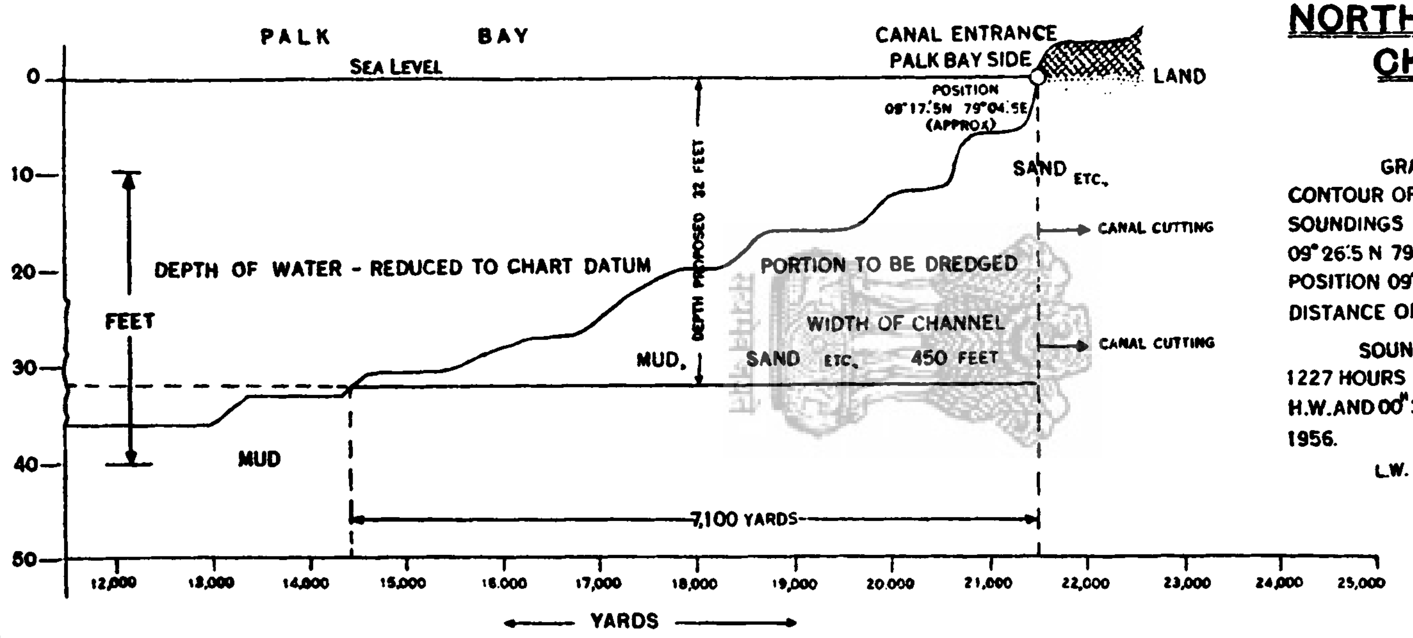
NORTH APPROACH CHANNEL

5



GRAPH SHOWING DEPTH OF WATER AND CONTOUR OF THE SEA BOTTOM AS INDICATED BY SOUNDINGS TAKEN ON A LINE 213° T. FROM POSITION 09°26.'5 N 79°10.'5 E (APPROX) TO THE SHORE IN POSITION 09°17.'5N 79°04.'5 E (APPROX) OVER A DISTANCE OF 10.6 MILES.

SOUNDINGS TAKEN FROM 1030 HOURS TO 1227 HOURS I. E. DURING THE PERIOD 02^{H} 36^{M} BEFORE H.W. AND 00^{H} 39^{M} BEFORE H.W ON THE 23 RD FEBRUARY. 1956.

L.W. 07^{H} 41^{M} 0.8 FT. H W. 13^{H} 06^{M} 1 5 FT.

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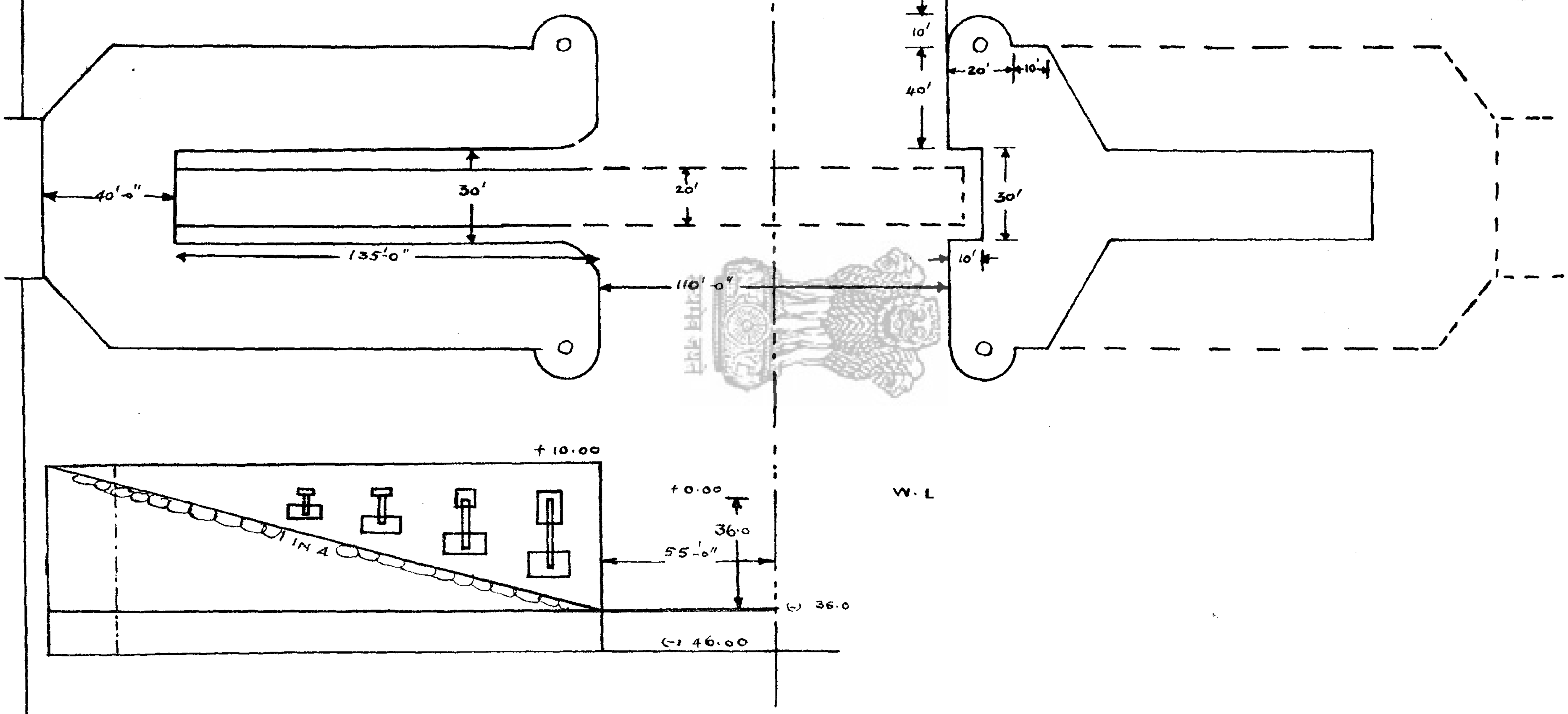
PROPOSED LOCK & LOCK GATE (TENTATIVE).

SCALE: 1/480.

⑥



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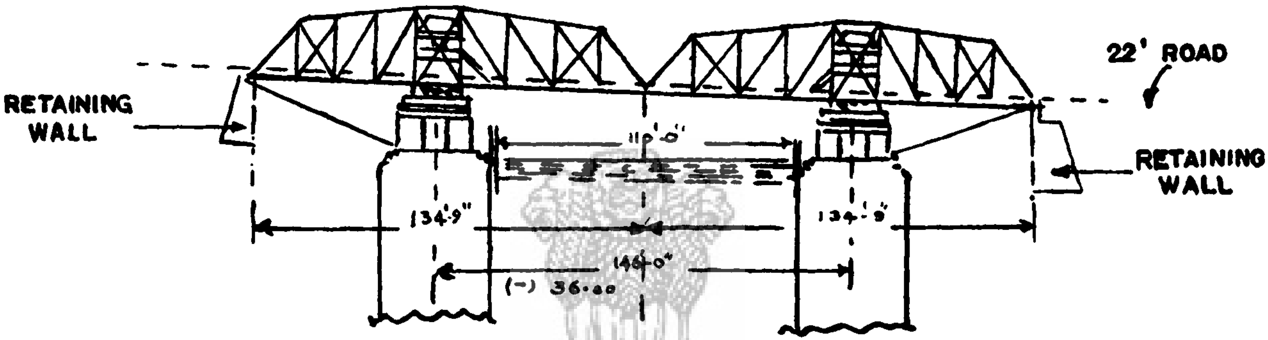
⑦

PROPOSED
DOUBLE ROTATING CANTILEVER DRAW BRIDGE
(TENTATIVE).

(NOT TO SCALE.)



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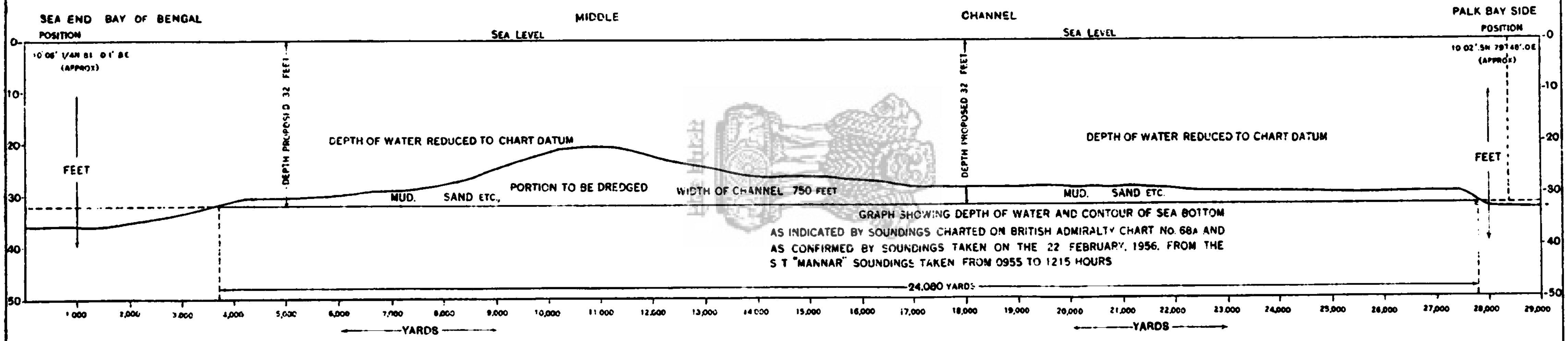
⑧

BAY OF BENGAL APPROACH CHANNEL



GRAPH SHOWING DEPTH OF WATER AND CONTOUR OF SEA BOTTOM AS INDICATED BY SOUNDINGS CHARTED ON BRITISH ADMIRALTY CHART NO. 68A AND AS CONFIRMED BY SOUNDINGS TAKEN ON THE 22 FEBRUARY, 1956. FROM THE S T "MANNAR" SOUNDINGS TAKEN FROM 0955 TO 1215 HOURS

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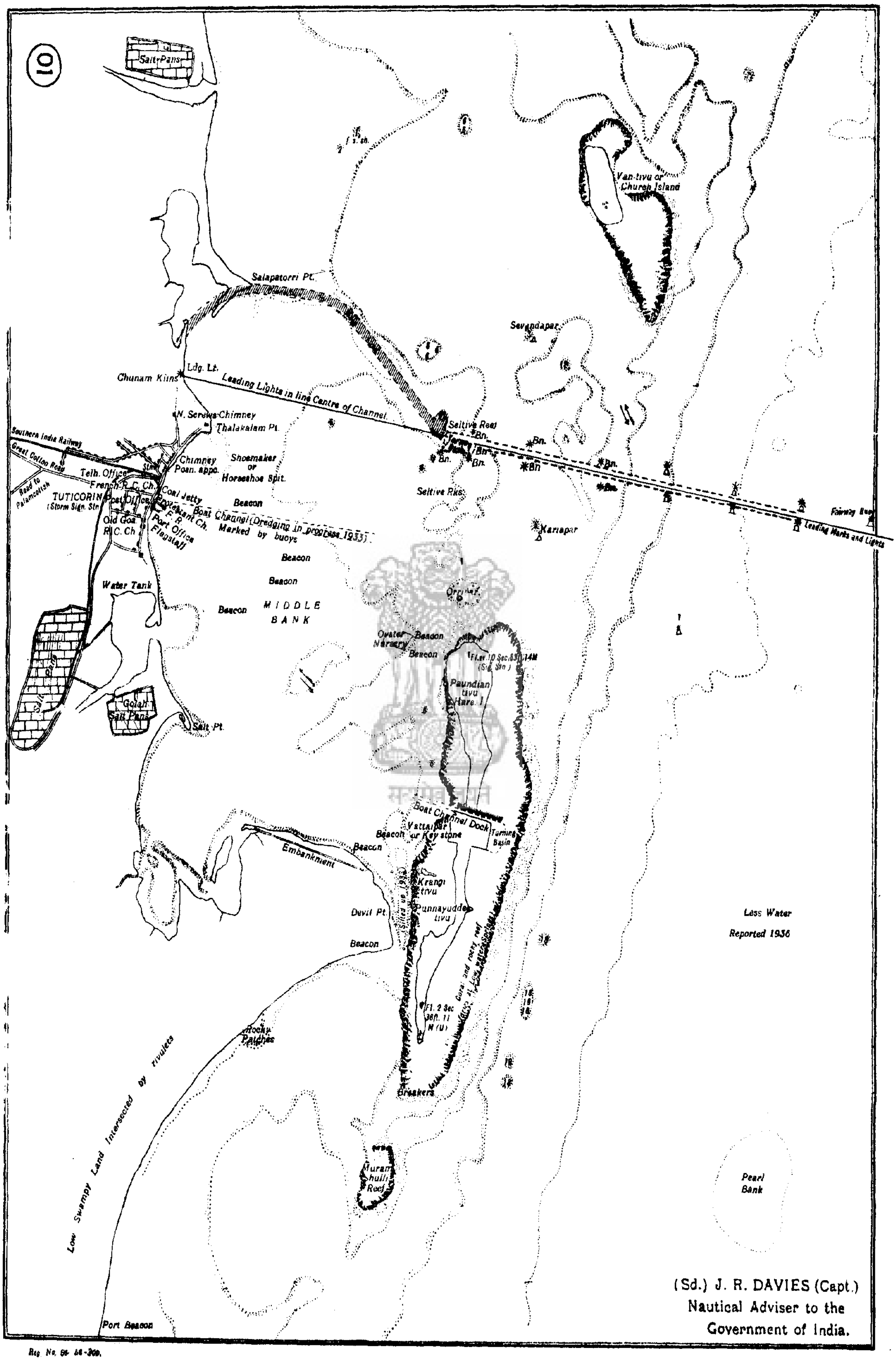
DEVELOPMENT OF TUTICORIN FOR SHIPS OF 30 FEET DRAUGHT INSIDE THE HARBOUR



(Sd.) J. R. DAVIES (Capt.)
Nautical Adviser to the
Government of India.

Helio. P. Z. P., C. S. O., Madras.